Technology Review

EDITED AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY NOVEMBER/DECEMBER 1993 $3.75

Technology Without Humanity

LESSONS FROM THE FAILURES OF THE SOVIET UNION

ALSO IN THIS ISSUE:

- SUPER MARIO GOES TO SCHOOL: TAPPING THE POWER OF VIDEO GAMES
- WOMEN OF THE MANHATTAN PROJECT
- NURTURING COMMERCIAL WINNERS WITH FEDERAL R&D
- THE PROMISE OF BONE MARROW TRANSPLANTS

technology
review
Published by MIT

Holiday Gift Suggestions *from Technology Review Gifts*

This holiday season, present someone you know with some of the fun and interesting titles listed here.

Especially for kids, the titles listed on this page will make great gifts for young and curious readers!

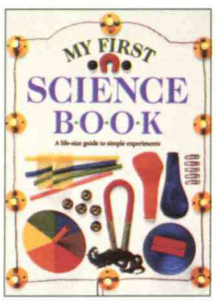
Snafooz Puzzles

These squishy foam puzzles will test your mettle and creative energy with dozens and dozens of complex shapes to build and rebuild. Six different levels to master, from easy to brain buster!

Ages 8 to adult, Package of 6, $6.95

My First Science Book

by Angela Wilkes

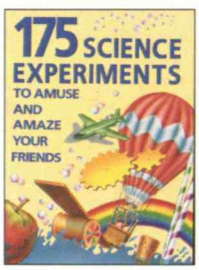


Kids can learn about the weather by making a rain gauge, barometer, and wind vane, or test acidity and alkalinity with their own litmus test. Includes instructions with color photographs, and clear explanations of why things happen. Over a dozen experiments.

Ages 6–10, Hardcover, 48 pages, $13.00

175 Science Experiments

by Brenda Walpole
Illustrated by Kuo Kang Chen and Peter Bull

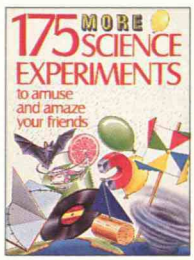


This collection of experiments will amuse and amaze every young scientist. Each page is filled with detailed full-color illustrations, photographs, and instructions on how things work and why things happen in our everyday lives.

Ages 8–12, Paperback, 172 pages, $12.00

New! 175 More Science Experiments

by Terry Cash, Steve Parker, & Barbara Taylor

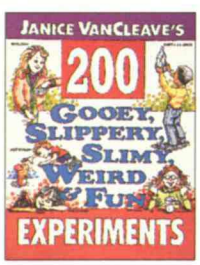


A sequel to the popular *175 Science Experiments*, this book brings further enjoyment to curious kids. Within four main sections—Sound, Electricity, Simple Chemistry, and Weather—it provides a lively menu of experiments, tricks, and things to make.

Ages 8–12, Paperback, 172 pages, $12.00

New! 200 Gooey, Slippery, Slimy Experiments

by Janice VanCleave

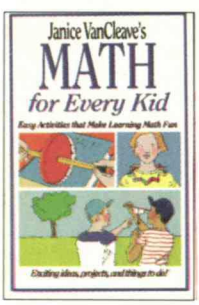


Zany, wacky, entertaining, this book engages children's imaginations while answering their favorite questions about the environment. Your kids will have so much fun conducting these 100% fool-proof experiments they'll forget they're learning.

Ages 8–12, Paperback, 172 pages, $12.00

Math for Every Kid

by Janice VanCleave

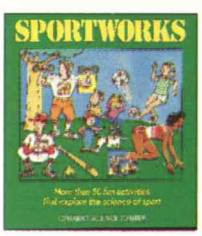


Easy activities that make learning math fun! Packed with illustrations, *Math for Every Kid* uses simple problems and activities to teach kids about measurements, fractions, graphs, geometry figures, problem solving and more!

Ages 8–12, Paperback, 215 pages, $10.95

Sportworks

by the Ontario Science Centre
Illustrated by Pat Cupples

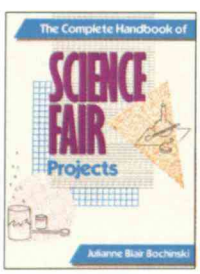


Why does a curveball curve? What makes a good football helmet? How do figure skaters spin so fast, and don't they get dizzy? You find answers to these sports mysteries and much more in this fun-filled book by the world-famous Ontario Science Centre.

Ages 8–12, Paperback, 96 pages, $8.95

The Complete Handbook of Science Fair Projects

by Julianne Blair Bochinski



The only book you'll need for selecting, preparing, and presenting award-winning science fair projects. Written by a veteran contestant and judge, this step-by-step guide describes 50 projects in detail and suggests 500 other topics suitable for grades 7 and up.

Ages 12 and up, Paperback, 206 pages, $12.95

The Scientific Kid

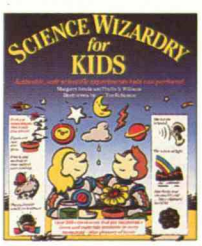
Written and illustrated by Mary Stetton Carson
Photographs by Sing-Si Schwartz

A collection of 35 fun experiments and projects to teach your kids some basic scientific concepts, from a vinegar and baking soda reaction to static electricity.

All ages, Spiral-bound, 78 pages, $13.00

New! Science Wizardry for Kids

by Margaret Kenda and Phyllis S. Williams



More than 200 authentic, safe experiments that use everyday, inexpensive materials. Kids will get to know the thrill of discovery by looking at their immediate world: making toy boats, brewing sun tea, growing violets, collecting rocks. Includes step-by-step instructions and glossary.

Ages 9-12, Spiral -bound, 316 pages, $13.95

Do's and Taboos Around the World

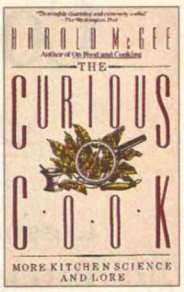
Edited by Roger E. Axtell

This fascinating guide helps thousands of high-powered executives and tourists avoid the missteps and misunderstandings that plague the world traveler. It includes facts and tips on protocol, custom, etiquette, hand gestures, body language, idioms, and gift-giving.

Paperback, 200 pages, $12.95

New! The Curious Cook

by Harold McGee

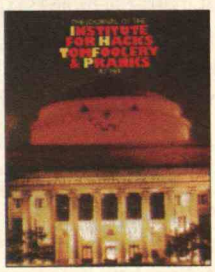


How can you keep the green in guacamole and pesto sauce? What's the best way to make fruit ices? Packed with fascinating scientific lore, *The Curious Cook* answers these questions and more to help the home cook make use of scientific discoveries about food.

Paperback, 339 pages, $13.00

Journal of the Institute for Hacks, Tomfoolery & Pranks at MIT

by Brian M. Leibowitz



This hilarious book recounts the history, folklore, and ingenuity of MIT students in their quest for the ultimate prank. From welding trolley cars to their tracks to steers grazing atop the great dome, this journal captures the spirit and playfulness of a rich MIT tradition.

Paperback, 158 pages, $19.95

The Epicurean Laboratory: Exploring the Science of Cooking

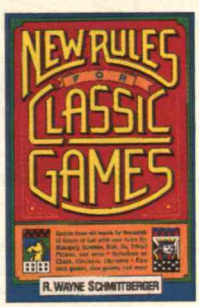
by Tina Seelig

Like a scientist, a chef makes interesting discoveries through constant experimenting. This beautifully illustrated book explains many of the scientific principles behind the art of cooking. It also includes 22 mouth-watering recipes—from salmon mousse to popcorn nachos to tangerine jam.

Paperback, 157 pages, $15.95

New Rules for Classic Games

by R. Wayne Schmittberger

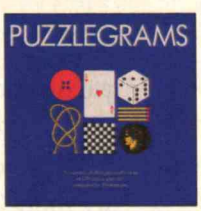


If rules are made to be broken, then dust off those old games lying dormant in your closet, because your game playing just got a lot more exciting! This book is a complete guide to hundreds of new twists and variations guaranteed to expand and enliven your game repertoire.

Paperback, 245 pages, $9.95

New! Puzzlegrams

by Pentagram

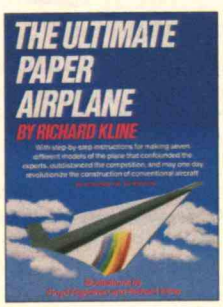


A collection of 178 classic puzzles recreated by one of the world's leading design firms. The book is a stunning, four-color combination of design and conundrum. It appeals to all ages and levels of expertise—and challenges your intuition as well as your intellect.

Paperback, 187 pages, $15.95

The Ultimate Paper Airplane

by Richard Kline

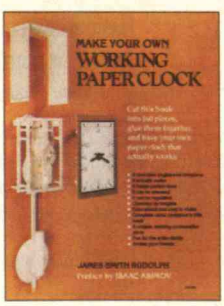


More than just a toy, the Kline-Fogleman airfoil earned its inventors two patents and was tested by NASA. Here is the story of its creation, along with the secrets behind its unmatched performance. Plus, instructions and patterns for making seven different models.

Paperback, 126 pages, $8.95

Working Paper Clock

by James Smith Rudolph



A remarkable book that can be transformed into a working clock. Cut it into 160 pieces, add a few odds and ends and glue them together. You'll have a piece that keeps perfect time. A fun and challenging project for you and your friends!

Paperback, $13.00

Order Form

How to Order

To order by phone:
Call (617) 253-8292,
Monday–Friday, 9 a.m.–5 p.m. EST.
Please have credit card information ready.

Or, send this form with payment to:
Technology Review Gifts
MIT W-59, Cambridge, MA 02139

Qty	Title	Price	Total

Bonus Savings!

For 3 or 4 items subtract $1.00

For 5 or more items subtract $2.00

Number of items	Shipping in the U.S.	Outside U.S. Surface Mail
1	$2.00	$3.25
2	$2.75	$5.00
3–4	$3.50	$6.75
5–6	$4.25	$8.50

← Shipping

Grand Total

Ordered by:

Name _____

Address _____

City _____

State _____ Zip _____

Ship to:

Name _____

Address _____

City _____

State _____ Zip _____

Payment

Prepayment in U.S. funds only is required.

Check or money order is enclosed for $ _____

Charge my: ☐ Visa ☐ MasterCard

Acct. No.: _____

Exp. Date: _____

Signature: _____

TECHNOLOGY REVIEW
NOVEMBER/DECEMBER 1993

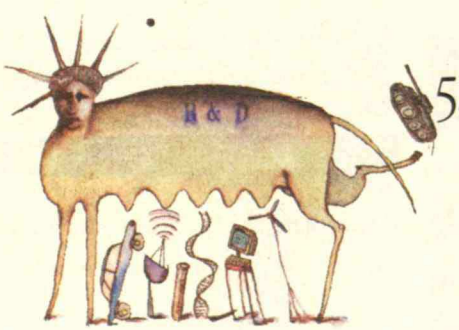
Contents

FEATURES


22


32


50



58

Cover: A young worker at the 1931 construction site of the steel city of Magnitogorsk—prominent among Soviet projects that were typically of inappropriate size and unmindful of local conditions.

PHOTO: MARGARET BOURKE-WHITE

TECHNOLOGY REVIEW
VOL. 96/NO. 8

DEPARTMENTS

9

12

72

78

Technology Review (ISSN 0040-1692), Reg. U.S. Patent Office, is published eight times each year (January, February/March, April, May/June, July, August/September, October, and November/December) by the Association of Alumni and Alumnae of the Massachusetts Institute of Technology. Entire contents ©1993. The editors seek diverse views, and authors' opinions do not represent the official policies of their institutions or those of MIT. We welcome letters to the editor. Please address them to Letters Editor.

Editorial, circulation, and advertising offices: *Technology Review*, Building W59, MIT, Cambridge, MA 02139, (617) 253-8250; FAX (617) 258-7264. Printed by Lane Press, S. Burlington, VT. Second-class postage paid at Boston, MA and additional mailing offices. Postmaster: send address changes to *Technology Review*, MIT, Building W59, Cambridge, MA 02139.

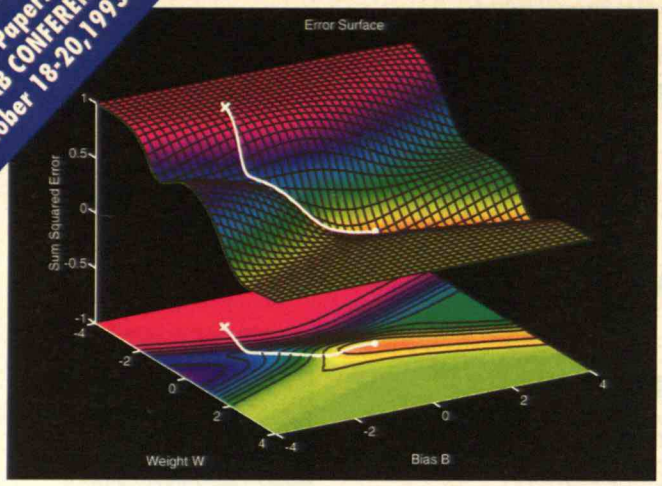
Subscriptions: $30 per year. Canada add $6, other foreign countries add $12. Contact *Technology Review*, P.O. Box 489, Mount Morris, IL 61054, (800) 877-5230 or (815) 734-1116; FAX (815) 734-1127.

Advertising representatives: Mark E. Lynch, Eastern Sales Manager, 9 Salem Drive, Saratoga Springs, NY, (518) 583-6086; The Leadership Network: Kiki Paris, 200 Madison Ave. New York, NY 10016, (212) 686-1734; The Noblehart Group, Charles Hollingsworth, P.O. Box 15478, Washington, DC, (202) 547-8488.

Printed in U.S.A.

BPA INTERNATIONAL

Call for Papers for MATLAB CONFERENCE October 18-20,1993



Graphics enhance understanding of neural network behavior. This surface and contour plot shows the descent of a backpropagation network from initial conditions to the minimum error.

Take command with neural networks, whether or not you've completed basic training.

Both newcomers and experts will find the MATLAB® Neural Network Toolbox to be ideal for the design, training, and simulation of neural networks in fields as diverse as signal processing, pattern recognition, nonlinear control, and financial forecasting.

Extensive functionality

Within the Neural Network Toolbox, you can choose from a comprehensive set of proven paradigms, including backpropagation, associative, Hopfield, and self-organizing networks.

You can design recurrent or feedforward networks, using supervised or unsupervised training.

Finally, with no limits on network size or architecture, you can implement networks as complex as your application demands.

The first Neural Network Engineering Environment

Departing from the traditional "canned" approach of other neural network packages, the MATLAB Neural Network Toolbox is actually a comprehensive engineering environment for neural network research, design, and simulation.

Flexible data import and transformation capabilities simplify preprocessing of network training data. Powerful analysis and visualization functions help you understand network behavior and evaluate performance.

Also, you can use other MATLAB application toolboxes and nonlinear simulation to compare neural networks with other methods to create optimum solutions.

The only truly open system

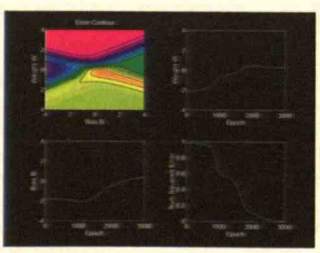
The Neural Network Toolbox is truly open and extensible. You can easily customize the built-in functions or even add new paradigms—all in the high-level MATLAB environment, without having to write a single line of C or Fortran.

Not just for experts

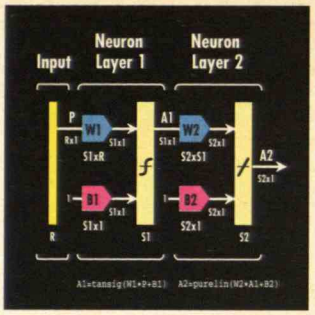
You don't have to be an expert to put the MATLAB Neural Network Toolbox to immediate use. The comprehensive User's Guide makes learning a breeze, with examples of how to solve real world problems.

Your choice of platforms

The MATLAB Neural Network Toolbox runs on PC, Macintosh, UNIX workstations, VAX/VMS, and supercomputers, and your neural network applications can be easily moved between them.



Evaluate performance at a glance with the help of built-in diagnostic routines and graphs—or create your own



Concise notation makes it easy for all to understand complex network architecture.

So, whether you are an expert or just getting started, discover the true power MATLAB brings to neural networks. Call us now for more information,

508/653-1415.

MATLAB Neural Network Toolbox

- *Extensive proven paradigms for supervised and unsupervised networks, including:*
  - *Perceptron*
  - *Widrow-Hoff*
  - *ADALINE/MADALINE*
  - *Backpropagation (with momentum, adaptive learning)*
  - *Associative networks*
  - *Hopfield networks*
  - *Self-organizing networks including feature map*
- *Competitive, limit, linear, and sigmoid transfer functions*
- *Feedforward & recurrent architecture*
- *Performance analysis functions & graphs*
- *Unlimited layers, elements, & interconnections*
- *Acclaimed "textbook quality" user guide*

The MATH WORKS Inc.

24 Prime Park Way, Natick, MA 01760-1500
Tel: (508) 653-1415 Fax: (508) 653-6284
Email: info@mathworks.com

France: Scientific Software, +33-1-45-34-23-91
Germany: Bausch-Gall GmbH, +49-89-995-9010
Israel: Omikron Delta, +972-3-561-5151
Japan: Cybernet Systems, +81-3-3982-4641
Scandinavia: CSEAB, +46-8-15-30-22
Switzerland: COMSOL AG, +41-31-961-70-11
U.K.: Cambridge Control, +44-223-421-920
U.K.: Rapid Data Ltd., +44-903-202-819

First Line

Talk, Talk, Act, Act

WHEN I lived in France some years ago I was much impressed with its citizens' constant celebration of their remarkable heritage. But the glory of the past seemed to have remained in the past. The creation of social, cultural, and scientific advances—once a prominent French enterprise—had now mostly shifted elsewhere, and many of the folks I met conveniently seemed to think that modern society's major ills tended to occur elsewhere too.

"You have horrible pollution problems in the United States," Parisians often remarked to me, in a city whose air was virtually unbreathable and whose river resembled an open sewer. Or people would say "you have horrible race-relations problems in the United States," while France's large and largely segregated work force imported from former African colonies to perform menial tasks seemed to my American sensibilities just a step removed from slave labor.

I remember thinking not only that this myopic view was a barrier to progress but also that I was proud of my own compatriots' bite-the-bullet, admit-your-problems attitude, which *enabled* progress. Yet lately the United States also seems to have become a fading power: we too are living largely off the creations of our predecessors, and are consigned to watching the progress made elsewhere by the leaner and meaner.

We still readily admit our shortcomings, but what used to be honesty as a prelude to action has become so much empty talk; our leaders in the public and private sector alike seem more intent on delivering jeremiads on the country's problems than on doing much about them.

"This report says U.S. education is mediocre," notes a serious-looking man in a *Boston Globe* cartoon by Dan Wasserman. "This [second] report says U.S. industry is stagnating. And this [third] report says the U.S. budget is a shambles."

"Don't we excel in anything?" asks his companion.

"Writing reports," he answers.

To me the main symptom of our growing has-been status is that we also excel in conveniently looking elsewhere. We may loudly proclaim our own problems, but when push comes to shove most of us seem to believe that things are far worse in other countries and that we are somehow exempt from their mistakes. And what better whipping boy could we devise these days than the Soviet Union—a nation that no longer exists. As winners of the Cold War, we can easily deride the hapless nation's long list of errors, but from this history we have some important lessons to learn.

After admitting our nation's problems and noting those of others, Americans should say less and do more.

Consider historian Loren R. Graham's cogent article in this issue, "Palchinsky's Travels: A Russian Engineer's Adventures Among Gigantic Projects and Small Minds." Graham recounts Soviet policies that differ in specific circumstances from those of the United States yet are similar enough in their fundamentals to give us pause. Domination by a ponderous and centralized federal government; a penchant for gigantic enterprises that are long on symbolism and cost but short on payoff; and a "flight from production" of so many of the country's most capable minds are only a few of the uncomfortable parallels. But the most chilling for me, because it is so basic, is the "intellectually impoverished" education of engineers.

Graham describes the ludicrously narrow Soviet engineering curriculum that "avoided touching on politics and social justice, concentrating instead on science and technology of the most specialized kind." This curriculum not only produced engineers "with a strikingly circumscribed vision" but who, as luck would have it, comprised much of the USSR's political leadership. Meanwhile, although few colleges in the United States grant bachelor's degrees in "ball-bearing engineering for paper mills," this country too has long suffered from the narrow education of its engineers—and indeed of so many other professionals who influence, or become, our leaders.

"It's not a proper professional education," asserted engineer-writer Samuel C. Florman, in an article I wrote a few years ago for the *New York Times*. "The average engineer is basically a high school graduate with technical training." In the same article, the dean of engineering at my alma mater, the City College of New York, explained the rationale for this system: "Industry wants engineers early and it wants them to produce right away." Yet as in the Soviet Union, the rush could be counterproductive. Writer Mubarak Dahir reported in the last issue of *Technology Review* that a recent survey by the National Society of Professional Engineers found many industrial employers dissatisfied. Their experience, he said, showed that "current engineering baccalaureate programs do not produce engineers who can meet their company's basic needs."

Things could be different. Engineer Peter Palchinsky, the hero of Graham's story and a well-rounded professional trained before the birth of the Soviet juggernaut, came to insist not only on "viewing engineering plans within their social and economic contexts," as the author puts it, but on "an ambitious role for engineers." Palchinsky believed that "the engineer must emerge as an active industrial planner, suggesting where economic development should occur and what form it should take."

None of this is possible, of course, if we concentrate on the mistakes of others while discounting our own, or if merely talking about a problem is considered a sufficient remedy.■

—STEVEN J. MARCUS

Letters

THE MEDIUM IS NOT THE MESSAGE

The silliness about *Jurassic Park* has gone on much too long without a response such as the one Steven J. Marcus offers concerning the images of scientists (*"Climbing Down from the Pedestal," TR First Line, August/September 1993*). I have just three small points to add.

First of all, the widespread, trendy belief that perception is reality has given undue importance to press agents, and it has also provoked unreasoned fear about the supposed power of popular entertainment. In fact, people are not idiots; they know reality is not defined by movies or PR campaigns. It is a serious error to imagine that Murphy Brown is a real person, or that *Jurassic Park* has the power to impede biotechnology.

My second point is that many people have taken up a nasty idea whose origins lie in what has been called postmodernist academic fascism—namely, that criticism is deleterious in itself and that those who are criticized can legitimately say, in effect, "Stop hurting us." Such brain-dead doctrines arose in the humanities, and I'm discouraged to see spokespeople for the sciences adopting them, particularly when the truth is exactly the reverse: criticism is invigorating and useful. Indeed, the only danger arises when criticism does not occur.

Finally, one clear effect of all this press flackery and lit-crit sensitivity has been to make large numbers of people lose their sense of humor and proportion—so much so that they find it necessary to express deep concerns about a *dinosaur movie*. Frankly, I think that's a stunning outcome.

MICHAEL CRICHTON
Santa Monica, Calif.

RESEARCH WITH SOCIAL GOALS

"A New Social Contract for Science" by Langdon Winner (*TR May/June 1993*) presents some good ideas about where we should go with science policies but misstates where we have been.

To be specific, Winner argues that research in the United States has been conducted under the basic understanding that "government should not attempt to direct inquiries toward specific social ends." But as much as two-thirds of government-sponsored R&D over the last decade has been channeled through defense agencies. Also, defense procurement patterns have helped direct as much as 40 percent of total R&D toward military ends. It is impossible to argue that the government has not had a heavy hand in directing the bulk of U.S. research toward a specific set of social ends—military ones.

The first priority in setting a new science agenda is to redirect large chunks of this funding toward more humanistic and timely social priorities. Since the Cold War ended, very little progress has been made toward this goal. Greater civic participation, such as Winner advocates, would be a positive step.

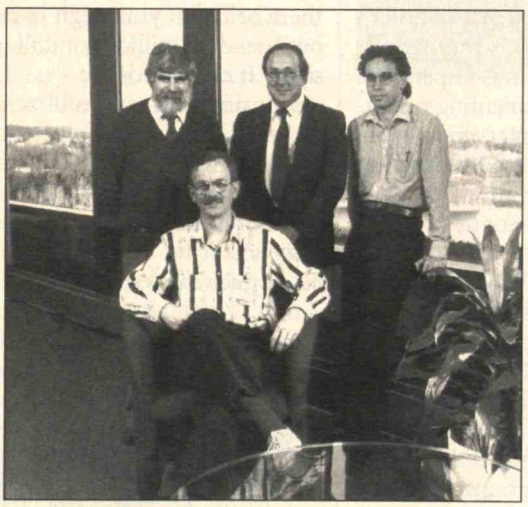
DOMENICK BERTELLI
Director
Conversion Information Center
Council on Economic Priorities
New York, N.Y.

INDUSTRIAL EXTENSION

In an otherwise excellent article (*"Industrial-Strength Aid for Small Businesses," TR July 1993*), Leo Reddy states that the federal government "did not start industrial extension services until 1988." He—like *Business Week*, the Office of Technology Assessment, and many others—appears to have a short memory. Some 20 years ago this country had a federally funded, state-based industrial extension service, established under the State Technical Services Act of 1965 (STS). In fact, many of the most successful existing state programs were created under the STS program.

While it is important to set the record straight, it is perhaps more important for today's advocates of industrial extension to revisit the past and learn why this program, despite its many successes, turned into a political failure. One of the base problems of STS was the belief that the successful land-grant model could be adapted to industrial extension. As those of us involved in that program

Engineering Manager



In the Bose corporate library, clockwise from the left, are Joseph Killough, Bill Schreiber, Dick Kirkpatrick, and Richard Saffran, members of the Bose Engineering Team.

Bose Corporation is among the most successful American companies competing in the international consumer products marketplace. We welcome exceptional engineers with imagination and courage who wish to pursue their ideas in an innovative team environment.

Bose Corporation seeks a highly successful and capable Engineering Manager to direct the development of a new, advanced electronics product. Your responsibilities will include guiding the technical design, managing the team and working with related organizations to ensure the successful introduction of the product into manufacturing.

Engineering Experience
You must have designed several products which achieved production, preferably in a high-volume application. The design should include analog, RF, power supplies, DSP or microprocessors.

Management Experience
Your career must have included 3 years as a manager of projects (including schedule and budget responsibilities) and as a manager of engineers including hiring and performance review responsibilities.

Education Experience
A minimum of a BSEE is required; MSEE is preferred. A strong grasp of the principles of electrical engineering and their application to a wide range of problems is necessary.

Job Responsibilities
The successful candidate will lead a group of 6-10 technical professionals in the design of a new, high-volume, advanced technology product. Your role will include working closely with manufacturing, purchasing, quality and marketing organizations as you lead your team to meeting the challenge.

To further explore this opportunity please reply, in confidence, to Heather Sweeney, Bose Corporation, The Mountain, Framingham, MA 01701-9168. An equal opportunity employer.

BOSE®
Better sound through research.

learned, there are fundamental differences between agricultural and industrial extension.

MARTIN D. ROBBINS
Vice-President for University Relations
University of Toledo

Our work with hundreds of firms over the years supports Reddy's contention that extension services must go beyond "hard technology" and address work force, management training, and business issues. We have learned that our technical recommendations must be placed in the context of the firm's financial, organizational, and managerial structure. This is particularly true in smaller firms, which often find it difficult to "take a step back" from day-to-day operations and implement activities necessary for long-term survival.

Targeting is critical. Extension service providers must focus on key industrial sectors in their geographic area, and be well-equipped to deal with the issues they will encounter, thus building a favorable reputation among their clientele. This is particularly important for a publicly financed effort, which might otherwise be viewed skeptically by many owners of small firms.

Finally, we believe that evaluation of both the program and the results achieved by the client firm is imperative. Our own efforts at documenting performance before and after intervention provide valuable opportunities for program modification.

GEORGE H. KUPER
President
Industrial Technology Institute
Washington, D.C.

REALISTIC GOALS FOR NASA

In "A Fork in the Road to Space" (*TR August/September 1993*), David Callahan provides a well-rounded analysis of the American space program. A balance is badly needed between long-term U.S. space goals and current budget realities, and the space station program is preventing us from achieving it.

The concept of the space station is admittedly an exciting one. But the visions that have been promoted by the space travel adventures we grew up with are decades beyond our reach for several reasons. One is, sadly, economics. We cannot afford to make sizable financial investments in all promising projects during these lean fiscal times. Still, we can afford to continue what NASA does best: smaller projects that return real value for modest investments. Worthy programs that are likely to yield useful data without breaking the bank include the Comet Rendezvous/Asteroid Flyby and, notwithstanding the recent Mars Explorer failure, the Mars Environmental Survey. Actually, Mars Explorer was apparently scaled back to free up resources for the space station, and the case can be made that this contributed to the demise of that probe.

Another reality to be confronted is that NASA projects, most notably the space station, are spread about the country in such a way as to safeguard political support. That may ensure the life of these projects, but it creates a management nightmare. How do you oversee a space station being manufactured in 48 states, in well over 200 locations? Where do you begin to set quality control standards that will be adhered to? How in the world can you reign in costs without spending millions of dollars in oversight? It can't be done.

It is no shame to pull back from the wrong direction and reconsider. What would be a shame would be to continue along our current reckless course without a long-term policy that reflects not only scientific needs but political and economic realities.

REP. TIM ROEMER
(D-Indiana)
Washington, D.C.

COMPUTERS IN EDUCATION

We have a long way to go before children and computers are brought together in the school setting as envisioned by Seymour Papert (*"The Children's Machine," TR July 1993*). Still, I am encouraged by recent developments. First, I find that as computers become ubiquitous in our daily lives, teachers are more open to using them. We are starting to see prospective teachers who have used computers for years—my nephew will be the first of his generation of the family to attend college, and it is just assumed that he will not leave home without a personal computer. Second, use of computers is chief among the strategies for implementing the call for a new curriculum emphasizing problem solving and real-world applications.

Continued on page 76

MIT Reporter

Scientific Flying on the Cheap

Designing unusual aircraft is nothing new for Mark Drela, an associate professor of aeronautics and astronautics at MIT who has been building airplanes since he was four. But sending a pilotless craft 85,000 feet above the earth—nearly 12 miles, or one-third higher than the most sophisticated scientific plane can fly today—will be unusual. That's what Drela expects to do during an Antarctic launching of his Perseus aircraft this spring.

Perseus, which Drela calls "a poor man's satellite," can conduct a wide variety of scientific experiments, as long as the payload weighs no more than 400 pounds. To sample stratospheric ozone levels, NASA is paying $1.5 million for each of two copies of the plane from Aurora Flight Services of Manassas, Va., plus $100,000 per flight, while the most inexpensive satellites cost around $40 million.

As Aurora's chief aerodynamist—and a minority stockholder—Drela has designed a plane that weighs just 1,320 pounds and resembles a glider more than a satellite. He expects the craft will be yanked aloft to several hundred feet with a high-speed, motor-driven winch in the same way that a kite is lifted by running against the wind. Then the plane's 65-horsepower rotary engine should pull it up the rest of the way.

Perseus is expected to cruise at a speed of 200 knots in the stratosphere over Antarctica, where many scientists consider ozone depletion to be at its worst. Perseus should follow a preprogrammed flight plan up to six hours before returning to the ground. If trouble develops, Drela's team can pilot the craft by remote control.

To construct Perseus, Drela relied on aerodynamic lessons he learned from Daedalus, the human-powered aircraft that he helped design and that was piloted 69 miles across the Aegean Sea in 1986. Both planes have large wings to generate lifting power: Daedalus had low engine power because it was propelled only by a cyclist's thighs, while Perseus is designed to fly at high altitudes where thin air provides less lift. To cut down on weight, Perseus' 60-foot wingspan and its body include layers of a paperlike, honeycomb material interwoven with stiff but lightweight graphite cloth, and a protective outside skin of Kevlar (also used in bulletproof vests).

The pilotless aircraft Perseus is designed to fly nearly 12 miles up in the sky, where it could help conduct research—for example, by sampling ozone levels in the stratosphere.

Drela also had to prevent other problems that would normally be caused by high-altitude flying. Perseus will carry liquid oxygen so that the engine can burn fuel in regions where oxygen is virtually nil. And since the stratosphere's low pressure would prevent the engine from emitting waste heat out the rear, the engineer designed a system for dissipating heat through radiators on the top and bottom of the plane's wings. Finally, Drela sealed the plane's electronic systems in a pressurized vessel to protect them from low pressure and temperature.

Lacking a craft such as Perseus, scientists have so far measured stratospheric gases using high-altitude weather balloons, which are at the mercy of unpredictable weather conditions during launch, or the ER-2 Condor, a former spy plane. The Pentagon mothballed the Condor earlier this year because of its $1.8 million yearly maintenance bill.

Perseus is safer than piloted scientific aircraft such as the Condor, points out Steven Wegener, deputy chief of NASA's Perseus project. He adds that if the plane succeeds past the testing stage, it could monitor hurricanes, ocean currents, atmospheric radiation levels, and other phenomena. Astronomers could even mount a small telescope aboard, he says. "It gives us a new tool."—*Eric Niiler*

A New Way to Keep the Heart's Arteries Open

A little more than a decade ago, balloon angioplasty was an experimental treatment for expanding the narrowed coronary arteries implicated in chest pain and heart attacks. Now carried out roughly 300,000 times a year, however, the procedure—which requires only a local anesthetic and thumbnail-sized incision—has become more common than open-chest, coronary-bypass surgery. Much as train engineers use a locomotive's cow catcher to push debris off rails, cardiologists expand and contract a tiny balloon inserted through a slim "catheter" tube along the interior of an artery to crack and plow through fatty blockages. The technique vastly improves blood flow to the heart.

But in up to half of these procedures, the blood vessel narrows within six months at the very spot that was cleared, says cardiologist Robert D. Rosenberg, a professor of biology at MIT. Often the narrowing is caused by an uncontrolled growth spurt of the smooth-muscle cells that support the artery's walls. While some growth is natural, "it's suspected

PHOTO: AURORA FLIGHT SCIENCES CORP.

that [the extra growth] is the healing process gone awry," he says.

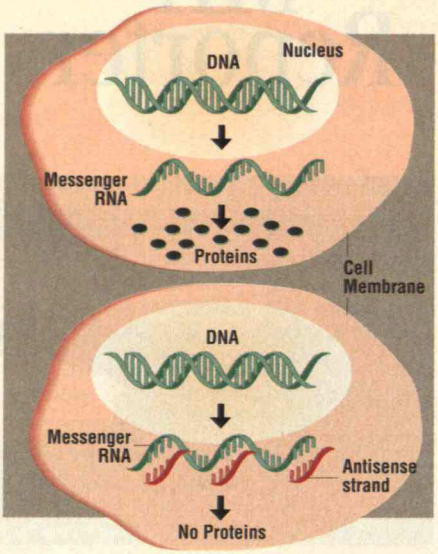
Searching for a solution, researchers in Rosenberg's lab have pioneered a gene therapy that in rats has kept a cellular messenger from opening the floodgates to rapid duplication of smooth muscle cells.

The therapy involves a compound that is a member of an emerging class of "antisense" agents that are believed to block genetic messages. Normally, instructions to build a protein assigned to a specific job such as replicating smooth muscle cells pass from the DNA inside a cell's nucleus to the "messenger" RNA. That in turn exits the nucleus and directs other parts of the cell to produce the protein. Researchers theorize that an antisense agent, which is created as a mirror image of the relevant messenger RNA, binds to it like one side of a zipper meeting the other. This keeps the strand of messenger RNA from completing the linkup necessary to produce the protein.

In their rat experiment, Rosenberg and chief investigator Michael Simons, a visiting MIT scientist and assistant professor of medicine at Harvard Medical School, performed balloon angioplasty on part of the neck artery. They then coated the vessel's outer layer with liquid infused with a particular antisense agent that should halt a gene believed to trigger replication of smooth-muscle cells. Tests done two weeks later—a good chunk of time given that the average rat lives only two to three years—showed up to 90 percent of possible smooth-muscle cell growth was prevented, so that the artery remained unblocked. Equally important, smooth-muscle cells supporting the blood vessel were unharmed.

"Until this worked, nobody had any experience doing this in animals," notes Simons, who along with Rosenberg owns stock in VasoRx, a new company funded by the biotech corporation Amgen to further develop their gene therapy. The researchers have since begun experimenting in rabbits and pigs.

The value of using an antisense agent to prevent smooth-muscle cell growth is that it should have "a very localized, pinpoint" effect, unlike the "blitzkrieg" effect of chemotherapy drugs, says Eric Topol, chair of cardiology at Cleveland Clinic Foundation. Researchers there have been trying to replicate the MIT work and also expand it in both rats and pigs.



When "antisense" strands are attached to messenger RNA—which carries the genetic instructions from DNA to produce proteins—the RNA cannot do its job. This phenomenon may lead to a method of treatment that prevents coronary arteries from narrowing again only months after balloon angioplasty.

While those efforts have been unsuccessful so far, investigators at Stanford University Medical School report achieving prolonged success in halting smooth-muscle cell growth in rats by wrapping, in an inactivated virus that can break through cell barriers efficiently, an antisense agent targeted at a different gene also thought to play a role in cell replication. The Stanford scientists are also conducting experiments in rabbits and pigs.

Whether these therapies are possible—as well as safe and effective—in people won't be known for at least several years. So far, no one has actually proven how these antisense agents work and determined how extensive their effects may be, notes Stephen Epstein, chief of the cardiology branch of the National Heart, Lung, and Blood Institute. An antisense agent might tamper with more cellular messages than the one targeted, for example.

Scientists also have to determine the optimal amount of antisense to use and the length of its effects in larger animals. "You need some growth of smooth-muscle cells to heal the artery" following balloon angioplasty, points out Topol.

And researchers want to find a way to deliver antisense directly to injured sites in the blood vessels. The MIT technique, which involves surgery to get to the artery, negates the advantage of balloon angioplasty, in which only a tiny slit is made to insert the catheter. Rosenberg's lab is experimenting with coating catheters and stents—tiny scaffolding used to prop upon blood vessels—with antisense. —*FRANCESCA COLTRERA*

REVERSE ENGINEERING THE HUMAN BRAIN

It's a subject often discussed in whispers: reverse engineering—analyzing a competitor's product to find out what makes it tick and then copying it. Richard Andersen, a professor in MIT's Department of Brain and Cognitive Sciences, is giving the term new respectability with an ambitious effort he describes as reverse engineering the human brain. Although the brain has long been used as a model for designing better computers, the work is among the first to demonstrate that computers can provide insight into how the brain works. The studies could also lead to neural-network computers that are better and more efficient learners than their predecessors.

Andersen and his colleagues at MIT and elsewhere have analyzed part of the brain's visual system and copied it with a network of computer "neurons" that has then been used to develop new hypotheses about vision. The research revolves around a fairly esoteric question: For decades, neuroscientists could not determine how—after someone looks at an object such as a coffee cup on a table and then moves his or her eyes away—the person can realize that the object hasn't moved. After all, the person's retina has formed multiple distinct

DIAGRAM: DEBORAH PERUGI

images of the object. Scientists knew only that the answer related to the posterior parietal cortex, the outer portion of the brain just above the ears on both sides. "Humans who get lesions in this area can't reach out and grab something," Andersen explains.

Trained as a neurophysiologist, Andersen first tried to solve the problem by using electrodes to record the activity of visual neurons in monkeys' brains. He showed that certain neurons in this group receive not only the signal about the image from the retina, which changes light into nerve signals, but also another signal (probably coming from the part of the brain regulating eye movement) that concerns the direction in which the eyes are pointing. He figured this out by noticing that the rate at which visual neurons produced electrical impulses changed as the monkeys' eyes moved. Clearly they were getting a second signal. Andersen concluded that the neurons somehow combine the two signals to determine whether the object has moved or the eyes have shifted position.

To mimic this activity, in 1986 Andersen and David Zipser, a professor of cognitive science at the University of California at San Diego, constructed the equivalent of a neural-network computer, which links chips through multiple connections so that they can act like neurons and perform many simple calculations at once. That is, they programmed a simulated neural network on a conventional computer. Zipser and Andersen used their setup, which roughly copied the brain's organization, to locate various objects repeatedly. After each trial, they improved the ability of the system to combine "retinal" and "eye-movement" signals through reprogramming.

Neurophysiologist Richard Anderson has shown that neural networks can accurately predict some of the workings of the brain.

PHOTO: MARK OSTOW

Confirmation from Monkey Tests

Once the system was thus trained, the researchers used it to hypothesize how the brain determines whether an object has stood still when a person moves his or her head (rather than just the eyes). Andersen now reports that tests with monkeys confirm that their brains work as the system predicted. Movements of the monkeys' heads changed the firing rate of electrical impulses in visual neurons.

Some neuroscientists have argued that Zipser and Andersen's computer set-up doesn't provide a good model of the brain, because people don't consciously recalibrate their neural wiring. In response, Andersen and his MIT colleagues have come up with a biologically plausible learning rule for the simulated network. Their mathematical formula requires only one input: the success or failure of the system at accomplishing a task, such as instructing an appendage to reach out and successfully grab an object. If the network succeeds, the formula automatically strengthens the likelihood that the "neurons" that have fired will do so again, while it reduces the chance that the "neurons" that haven't fired will do so.

Andersen is now using his network to predict how the brain accounts for the entire body's position when interpreting visual signals. He's looking at how the brain handles signals from muscles and joints, such as those in the legs, that indicate changes in overall body position. He is also collaborating with MIT engineers to design computer chips that include his learning rule, since it has existed only as software. Anderson says that the research should enable neural networks to learn more efficiently and ultimately lead to smarter robots.

—PAUL RAEBURN

Trends

Boom and Bus

Buses no longer need to be considered the lowest and slowest form of transportation, nor a last resort when commuter routes need to be expanded. At least that's the prevailing attitude in Curitiba, Brazil. The innovative bus network in this city of 1.6 million carries as many passengers as quickly as most subway systems. And what is making big-city transportation officials around the world sit up and take notice, the bus plan cost hundreds of times less to implement than the typical subway.

The heart of Curitiba's system is concentrated along five roads that radiate like spokes of a wheel more than 10 kilometers from the city center. These main roads, where buses travel in exclusive lanes, are woven together by 185 kilometers of suburban interdistrict lines and extended by 300 kilometers of "feeder" routes.

To minimize delays, bus stops are spaced no closer than 3 kilometers apart along nearly half—about 250 kilometers—of this spider-web-like network. And to streamline the boarding process at the most crowded bus stops, special cylindrical platforms—33 feet long and 9 feet in diameter—enable passengers to purchase fares in advance and enter and exit at the vehicle's level without climbing stairs. The tubes allow eight people to move in or out of the bus per second, four times the rate at conventional bus stops.

World's Largest Buses

Finally, to handle the huge throngs of passengers—half of Curitiba's total population, and three-quarters of its commuters, ride the system daily—the most popular routes are served by buses with three coach cars connected much like subway cars that each carry as many as 270 passengers. These articulated buses, nicknamed surface-subway cars, are among the world's largest. On their route, some 23,000 passengers are transported per hour, the same rate carried by the subway in Rio de Janeiro.

A novel public-transit system in Curitiba, Brazil—with huge-capacity buses, efficient loading platforms, and exclusive travel lanes—carries passengers as rapidly as subways can, but costs only a fraction as much to build.

Perhaps the most appealing aspect of Curitiba's novel system is that most of it cost only about $200,000 per kilometer to install, one-five-hundredth the cost of a subway, which internationally averages about $100 million per kilometer, according to an Urban Management Program report sponsored by the United Nations and the World Bank. The routes with articulated buses cost about $1.3 million dollars per kilometer, one-eightieth the cost of a subway.

What's more, in contrast to the experience of many cities in both developed and developing countries, Curitiba's public transportation does not have to be subsidized, says Josef Leitmann, an urban planner in the Urban Development Division of the World Bank. The Urbanization of Curitiba, a government agency that runs the system, pays private companies to operate and maintain the buses according to the number of kilometers they cover and the number of passengers they carry. The agency guarantees a monthly return for the bus companies of approximately 10 percent of the fare price, which has ranged from 20 to 40 cents, with unlimited transfers. The rest of the fare price covers the cost of constructing and maintaining the roads and terminals as well as planning and managing the system.

Because the price paid per kilometer is fixed, profit depends on each company's efficiency and productivity. The price-setting strategy and competition between bus companies guarantees affordable, high-quality transportation services.

Since the present system was implemented in 1991, nearly 30 percent of the inhabitants of Curitiba who own cars decided to commute using public transportation. Even though Curitiba has the country's second highest rate of car ownership per person—one car for every three people—its public transportation system is the most used in Brazil.

The city has embraced an approach, applicable to developing and developed countries alike, whose time has come, according to the former mayor, Jaime Lerner, architect of the transportation network. "Today it is difficult even in rich countries to build a complete underground system," he says. "London, Paris, Moscow, and New York, for example, were able to do it because they

Continued on page 17

PHOTO: INSTITUTO JAIME LERNER

Continued from page 12

started in the beginning of the century when it was less expensive to work underground." Now, because of the growing cost of laying new subway lines, especially in established cities, most new transportation lines will have to be above ground, he says.

In fact, cities such as New York, Vancouver, and Lyon are turning to Curitiba to find solutions for their transportation needs. New York tried out a modest version of the novel bus system for a six-week period last year, spending more than a quarter-million dollars to install four loading tubes and maintain and operate four buses on loan from Curitiba. The demonstration route was a 2.5-mile loop in downtown Manhattan with stops at South Ferry, City Hall, the World Trade Center, and the South Street Seaport.

The New York City Transit Authority, which will decide whether to implement the Curitiba system throughout New York, is so bogged down in maintaining its existing system that it has not yet had a chance to evaluate the results, according to Lawrence Gould, director of operations analysis. Still, others who participated in the demonstration remain cautiously optimistic. "The system could serve as an alternative to building expensive subway lines where we lack them," says Gerard Soffian, assistant commissioner of New York City's Department of Transportation.

Soffian also points out that laws forbidding cars to park in front of bus stops would have to be more strictly enforced. "Now, if a car is parked in a bus stop, the bus driver has the flexibility to stop in another place," he says. This cannot happen with the tubes."

To Lerner, the fact that New York City administrators have come to Curitiba to look for ideas to fulfill their transportation needs is not surprising. "If we are talking about rapid surface transportation, we have the know-how," he says. "They have very good buses, equipped with heating and air-conditioning, but this doesn't help if they are slow."—*NIRA WORCMAN*

Winning the War Against Mealybugs

A recurrent theme in science fiction involves uncontrollable organisms that escape into the world, wreaking havoc while the local inhabitants frantically try to destroy them. But fiction became fact when an agricultural scientist in South America flaunted strict international quarantine rules during the early 1970s and tucked a new strain of a cassava plant in his suitcase before boarding a plane bound for Africa. When he opened the suitcase he unwittingly released the mealybugs living in the plant and started an invasion that threatened to destroy the native cassava crop that provides half the food consumed daily by 200 million Africans.

The cassava, its root familiar to Americans as tapioca, had originally been brought to the African Congo River area from its native South America 300 years ago by Portuguese traders. Back then, the cassava mealybug (*Phenacoccus manihoti*), which longs for cassava like a five-year-old child craves chocolate ice cream, didn't survive the long boat trip across the Atlantic. But this time, on the short plane ride, it did. And unlike in South America, where natural predators keep its populations under control, in Africa the cassava mealybug found no effective enemies.

Thus the marauding bugs began their inexorable spread. In 1973, farmers in Zaire watched mealybugs destroy 80 to 90 percent of every infested field. Famine began spreading as crops failed. Whole villages were abandoned as farmers searched for areas where the mealybugs hadn't yet drifted in on the winds. The Zaire government, calling the mealybug invasion a national disaster, tried spraying chemicals and even ordered farmers to burn their fields, but to no avail.

In 1977, Zaire asked the International Institute of Tropical Agriculture in Ibadan, Nigeria, for help. At a meeting organized by IITA to devise a solution to the crisis, scientists agreed that prospects for controlling the mealybug looked dim. Spraying pesticides on cassava plants was nearly useless: mealybugs continually shed a waxy covering that repels contact

When pesticides failed to halt an Africa-wide invasion of cassava mealybugs, entomologists employed a tiny South American wasp, which lays its eggs in the mealybug's larvae, as a safe and effective means of biological pest control.

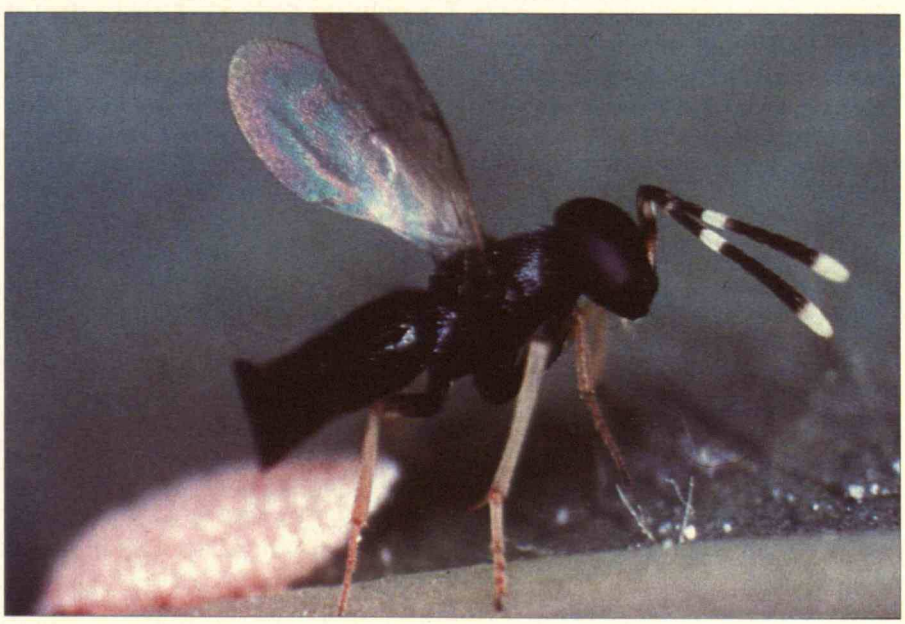


PHOTO: IITA-PHMD

African farmers, who harvest cassava roots as a staple food crop, returned to full production as the wasps brought the mealybugs under control in 30 countries across the continent.

poisons. And when mealybugs attack cassava leaves, a toxin in their saliva bunches the leaves around them, further protecting them from sprays.

With no short-term solutions in sight, IITA scientists began concentrating their efforts on finding a cassava variety resistant to mealybugs in time to avert a continental disaster. As an aside, in 1979 they gave a few thousand dollars and a small corner of a greenhouse to a Swiss entomologist named Hans Herren, a self-proclaimed "eco-freak" recently hired from the University of California at Berkeley, who had been lobbying vociferously to find the mealybug's enemy.

Herren's first step was to scour the fields and forests of South America to find the home of the invading *P. manihoti*, one of several dozen mealybug species. Two years later, one of Herren's colleagues, Anthony Bellotti, an entomologist at the IITA's sister agency, the International Center for Tropical Agriculture in Columbia, was visiting friends in Paraguay, one of the countries on Herren's list. Just before he left, he took a walk through a field and stumbled across *P. manihoti*.

Herren sent entomologists to the region to collect all possible mealybug predators and forward them to the International Institute for Biological Control in Great Britain, the world's center for the quarantine and testing of enemies of insect and weed pests.

The most important qualification for a good biological-control candidate was one that would eat only *P. manihoti* but no other insects or plants, and that would die off without it. The IIBC narrowed the field to two wasps, which Herren released in 1981 and 1982 in fields near Ibadan to test their second-most important qualification: an ability to endure the local climate.

Within one year Bellotti's tiny wasp, *Epidinocarsis lopezi*, no larger than a comma and too small to rate a common name, had spread throughout the experimental fields to three miles away, homing in on mealybug eggs in which to lay their own eggs. When the wasp eggs hatched into larvae, they quickly devoured the mealybug eggs.

By 1984, Herren was ready to spread the wasps across the 30 countries infested by the mealybug, which by then was causing $2 billion in crop losses annually. He developed a plan to breed millions of the wasps and release them at the rate of thousands per minute from three airplanes flying at 200 miles an hour.

"I asked IITA for $30 million for five years. People gave me a big laugh and said the project was too grandiose," he recalls with dismay. "When Los Angeles has a little medfly problem, it spends $150 million in one year on chemicals. Los Angeles is a dot on a map compared to the cassava mealybug infestation in Africa, an area one and a half times that of the entire United States."

Herren finally cajoled the European and Canadian chapters of the IITA to donate some $20 million over a 12-year period. It was enough to fund a scaled-down breeding program to produce 250,000 wasps a week, buy one airplane, and build a release system designed by some Austrian engineers to spit out 40,000 wasps at the rate of 100 per second from a plane without ripping off the insects' tiny wings.

In a test of this system during 1986, the wasps multiplied and spread so quickly that within five months they had spread in a circle 120 miles in diameter. And during the past seven years they have effectively brought the mealybug under control in 30 countries, as Herren and other IITA scientists, wasps in hand, have followed outbreaks of the cassava mealybugs across the continent in Rwanda, Malawi, Mozambique, Burundi, Tanzania, and Kenya, finishing up with a few spots in Uganda this year.

Meanwhile, Herren's biological control efforts have begun to catch on. As the team moved across the continent, it trained some 600 people in 36 countries to determine when infestations have occurred, identify the pests, and find, breed, disperse, and monitor the appropriate predators. Though the mealybug program is being scaled down, Herren—now director of IITA's expanded biological control programs—and his troops are now dispersing natural enemies for cassava green mites, corn borers, cowpea and banana pests, and other invaders that have slipped through national borders.

—*JANE STEVENS*

PHOTO: IITA-PHMD

Kid's Brainpower: Use It or Lose It

Parents and teachers have long known that a child's brain can soak up information like a sponge. But now researchers have scientific evidence to back up the theory, along with advice on ways to help children reach their full potential.

Perhaps the most convincing new corroboration of the young child's phenomenal learning capacity comes from neurologist Harold Chugani, head of the PET Center at the Children's Hospital of Michigan. While at the University of California, Los Angeles, during the 1980s, Chugani had been examining PET (positron emission tomography) scans to pinpoint the brain-seizure sites of his epilepsy patients. But he has also used these scans to observe which brain structures were metabolizing the most glucose and therefore were the most active.

By examining the glucose metabolization of patients ranging from newborns to adults, Chugani uncovered the timetable under which various regions of the brain develop. By age two, for instance, the cortex begins operating at adult activity levels. By four, a child's brain is more than twice as active as an adult's. The brain continues to consume glucose at this feverish pitch through age 10 and then slows down until age 16, when it levels off at adult values.

The child's brain burns much more glucose than an adult's brain, Chugani explains, because it must maintain trillions of connections between neurons, more than twice as many as are ultimately retained. "Initially, the brain provides too many connections in the cerebral cortex," he says. "Then there's a waiting period to decide which ones you want to keep."

These connections represent potential pathways that an electrical impulse may travel. Connections are strengthened by repeated use, and those that are not used become vulnerable to elimination. "The thing that determines which connections are saved is education in the broadest sense of the term," says UCLA's Michael Phelps, a biophysicist and co-inventor of the PET scan. "If we teach our children early enough, it will affect the organization, or 'wiring,' of their brains."

Unfortunately, U.S. education does not take full advantage of this opportunity, Phelps argues. For example, foreign-language instruction is often deferred until high school, despite the fact that youngsters can learn to speak like natives—that is, to think in the language without having to translate—whereas teenagers or adults usually cannot. When small children learn a new language, he says, "the ability to use that language is wired in the brain."

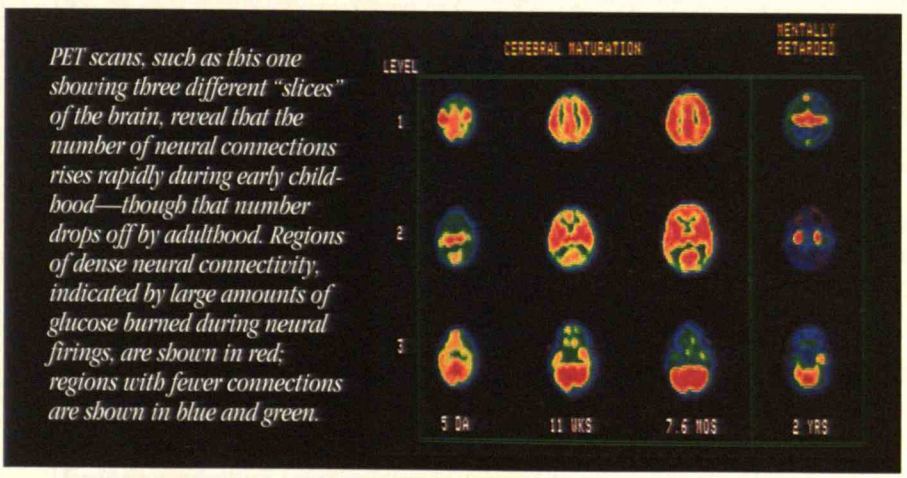
Musical training is another familiar example. "By encouraging young children to learn music and practice, you're really doing them a big favor," Chugani says. "Once a child has learned an instrument, he or she can stop playing, then pick up the instrument 20 years later and do much better than an adult just starting out."

Deprivation—the opposite of enrichment—can also permanently affect the organization of the brain. For instance, the language centers of the cortex are not able to reach full maturity without proper stimulation, says psychiatrist Arnold Scheibel, director of UCLA's Brain Research Institute. That's why so-called "feral" children who grow up in the wilderness without adults cannot master a language if they are brought back to civilization after the age of 10.

Likewise, experiments by neurobiologists David Hubel of Harvard and Torsten Wiesel of Rockefeller University have shown that cats can be blinded simply by covering their eyes during critical periods of infancy. Although the retina remains intact, the connections between the retina and brain are permanently impaired. When blindfolds are applied to adult cats, their vision is not permanently affected because the essential wiring is already in place.

The lessons from studies like these are clear, according to Martha Pierson, a neurobiologist at Baylor College of Medicine. "Children need a flood of information, a banquet, a feast." Early education, she adds, "shapes the basic architecture of the computer. If you are exposed to enough things, you'll develop a processor that can handle the flood of data that life throws at you later."

Merlin Wittrock, head of UCLA's Division of Educational Psychology, maintains that much of the instruction in today's schools is based on a flawed premise. "For a long time, we've assumed that children should get an immediate reward when they do something right," he says. Courses, therefore, typically revolve around exercises broken up into tiny chunks with answers supplied at every conceivable juncture. "But the brain is much more complicated than most of our instruction," Wittrock says. "It has many systems operating in paral-



PET scans, such as this one showing three different "slices" of the brain, reveal that the number of neural connections rises rapidly during early childhood—though that number drops off by adulthood. Regions of dense neural connectivity, indicated by large amounts of glucose burned during neural firings, are shown in red; regions with fewer connections are shown in blue and green.

PHOTO: HARRY CHUGANI

lel." In place of the usual "drill and practice" programs, he advocates complex problems without simple solutions that engage numerous systems in the brain and strengthen the connections among them. Because children may grapple with these problems for an extended period of time, the experience should also make a much more lasting impression.

Chugani concurs. Since repeated stimulation stabilizes the connections between neurons, he says, "it's better to expose a kid to a lot of things over a period of years, rather than trying to cover subjects one at a time in brief, intensive workshops."

UCLA's Scheibel cautions, however, that pushing our youngsters too hard can be counterproductive. "When the level of exposure becomes excessive," he says, "stress hormones are released that actually destroy nerve cells." A balance must be struck between too little exposure and too much.

Another important issue is the proper time to begin the educational process. Clearly we shouldn't force kids to learn too much too soon. "But why wait until age five," asks Yale biologist Martha Constantine-Paton, "when the evidence clearly shows that brain development begins much earlier." For example, she says, before a child can begin to learn how to read, the basic neural wiring has to be in place: kids have to be able to track things with their eyes, focus attention, and interpret symbols. This points to the importance of preschool programs like Head Start, she says, where children can get the stimulation necessary to prepare them for reading and other challenges ahead.

All of this is not to suggest that we should give up on educating adults. "Although there is a great window of opportunity for learning up to the age of 10," says Scheibel, "that doesn't mean you're over the hill at 12 or 14 or 40." Even in old age, the brain retains some "plasticity"—that is neurons can still grow and sprout new connections. If we stay healthy, he adds, "we can continue learning right up to the day we die."

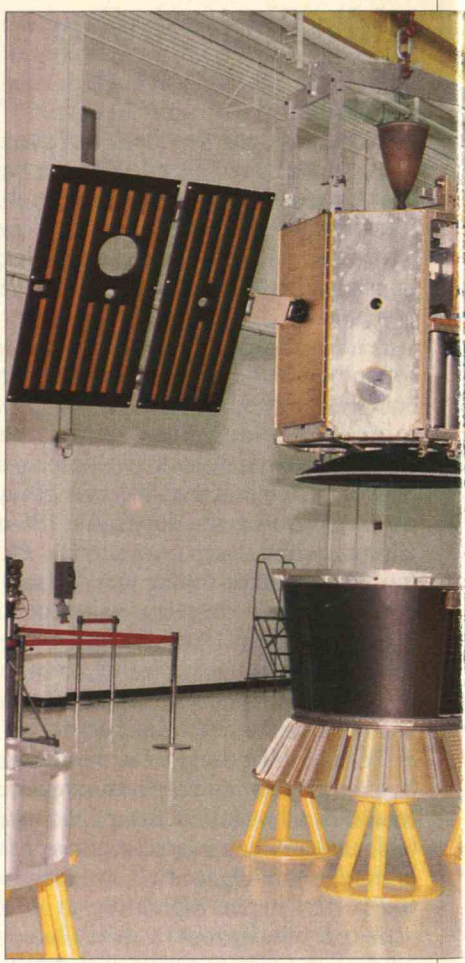
—*STEVE NADIS*

Exploring Space with 'Star Wars' Technology

In the past, NASA's space explorations usually didn't even cross flight paths with the Pentagon's "Star Wars" experiments. But now scientists from the two enterprises are teaming up on a mission.

A probe is scheduled to blast off this January from Vandenberg Air Force Base in California on the tip of a modified Titan 2 nuclear missile. The craft, named *Clementine*, first will orbit the moon, producing hundreds of thousands of lunar images using sensors attuned to ultraviolet, visible, and infrared light. In May, the spacecraft will fire its rocket thruster to break out of lunar orbit. And using earth's gravity to snap it like a slingshot, *Clementine* will aim for the asteroid Geographos as it makes its closest approach to the earth at a distance of approximately 3 million miles.

The probe will approach the chunk of ice and rock from its dark side—since the asteroid's elliptical loop around the sun will place it inside the earth's orbit—at a relative speed of more than 24,000 miles per hour. After the craft zips pasts Geographos next September at a distance of less than 62 miles, the asteroid's lighted side will swing into view. For several minutes, until it passes out of range, *Clementine* will furiously train its sensors on the asteroid, producing thousands of images.



The Clementine *space probe, to be launched in January, will enable NASA scientists to study the moon and asteroids, and "Star Wars" engineers to test new ballistic-missile sensors, solar cells, and guidance components.*

Dual Mission

While the mission promises to provide valuable scientific data about the moon and asteroids, the Pentagon's Ballistic Missile Defense Organization (BMDO, formerly called the Strategic Defense Initiative Organization) is funding the $75 million project to gain operating experience with a wide array of advanced, lightweight missile-defense components. These include a star-tracking camera that will help guide the spacecraft, a nickel-hydrogen battery that pound for pound delivers twice the electricity of previous spacecraft batteries, and solar cell arrays made of gallium arsenide and germanium that will recharge the batteries.

By scanning the moon and Geographos, *Clementine* will also test a variety of sensors that could be used to target incoming missiles. These include new infrared, ultraviolet, and high-resolution cameras as well as a charged-particle telescope to study solar-wind particles, which can damage electronics and cause

PHOTO: U.S. NAVY

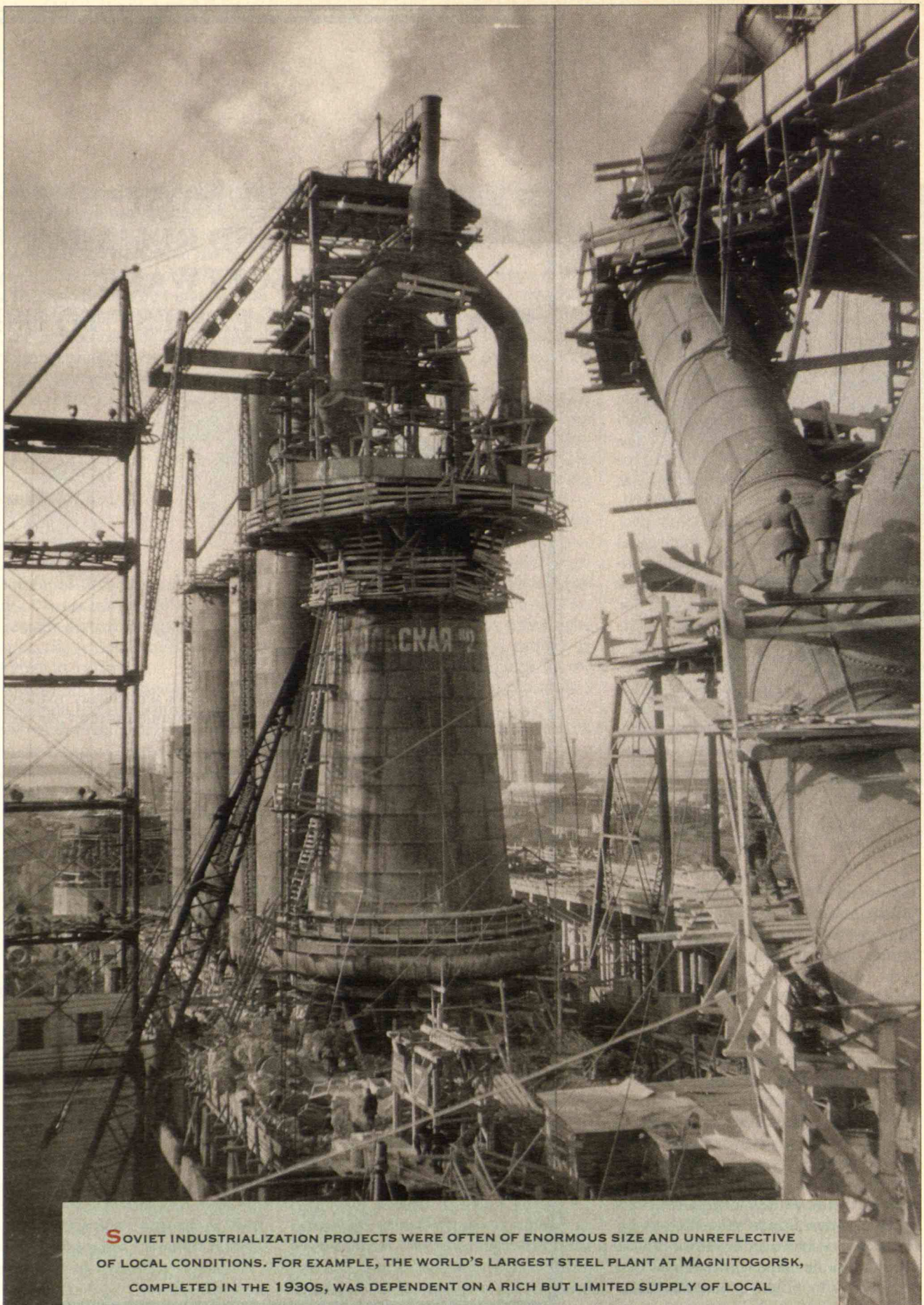
intermittent malfunctions. The solar radiation data will be useful because the exposure during *Clementine's* mission will likely be similar to the radiation that weapons would receive during several years in earth orbit.

Hunkering down for an era of tight budgets under the Clinton administration, Star Wars proponents see such projects as the best hope for keeping their research programs alive. Such dual missions will enable continued development of components essential for cost-effective space weapons, if and when a future president decides to field them, says Air Force Colonel Peter Worden, deputy for technology at BMDO. "This will help us keep the technological powder dry."

Thus the Pentagon is planning other missions that offer dual uses, including an array of experimental satellites known as the Miniature Seeker Technology Integration series. Program officials hope to launch two of the satellites during each of the next four or five years to test new miniaturized components, such as infrared sensors and satellite-stabilizing devices. As a side benefit, the satellites would gaze at earth, measuring cloud cover, surface temperatures, and other environmental variables.

Even the usual critics of Star Wars find little to bemoan in the new trend toward relatively inexpensive technology-demonstration projects that also have scientific value. "I think it's relatively harmless," says John Pike of the Federation of American Scientists. "It's a good use of the taxpayers' money."

—*VINCENT KIERNAN*



Soviet industrialization projects were often of enormous size and unreflective of local conditions. For example, the world's largest steel plant at Magnitogorsk, completed in the 1930s, was dependent on a rich but limited supply of local iron ore and on coal transported from afar.

PHOTOGRAPH: MARGARET BOURKE-WHITE

PALCHINSKY BELIEVED THAT HUMAN BEINGS ARE THE SINGLE MOST IMPORTANT FACTOR IN ENGINEERING DECISIONS, AND THAT SOCIAL JUSTICE AND EFFICIENCY COULD GO HAND IN HAND. IGNORANCE OF SUCH PRINCIPLES HELPED DOOM THE SOVIET UNION, AND IT HAUNTS THE REST OF THE WORLD AS WELL.

Palchinsky's Travels

A Russian Engineer's Adventures Among Gigantic Projects and Small Minds

BY LOREN R. GRAHAM

ON a cold night in April 1928, Stalin's secret police came to the Leningrad apartment of Peter Akimovich Palchinsky, a 54-year-old engineer, and arrested him. Palchinsky's wife heard nothing about his fate for more than a year when, on May 24, 1929, the Soviet newspaper *Izvestiia* published a short and shocking statement asserting that her husband had been the leader of an anti-Soviet conspiracy trying to overthrow the government and restore capitalism. It noted that he had been convicted without trial for treason and immediately executed by firing squad. ❧ Many years later the arrest and death of Palchinsky were briefly described by Aleksandr Solzhenitsyn in his *Gulag Archipelago*. Solzhenitsyn observed that the enormous collection of the prominent engineer's personal papers (covering more than 30 years' work) had disappeared into the "maw" of the secret police, "once and for all, forever." But during January 1991, in the midst of Gorbachev's reforms—62 years after Palchinsky's execution—I was permitted to inspect a government archive that had long been denied to scholars. And in it I came across a file on "P. A. Palchinsky" that over the following months and during three more research trips to Moscow turned out to be a bonanza. The entire collection of the engineer's papers slowly surfaced like a giant fish I was pulling from beneath

the water. Reading through these materials as the Soviet Union disintegrated around me, I saw that here was a clue to one of the riddles of Soviet history. Why had the USSR been unable to benefit fully from its impressive start in technological modernization? From its inception the leaders of the Soviet Union had put great emphasis on technology, launching programs of electrification, industrialization, and weapons building that inspired some Western observers and alarmed others. But in the course of two generations after the Russian Revolution, something clearly went wrong. We now see that this grand effort to master technology and use it for the nation's benefit was a monumental failure.

The usual explanation involves the limitations of a centrally planned economy, but that is only partially correct. After all, the Soviet economy worked well enough to build up an industrial establishment that was, in its heyday, the second largest in the world. So long as Soviet citizens had faith in their system it seemed to work fairly well, at least in comparison with other backward nations trying to modernize. Was there something about the way technology was used that contributed to the loss of faith and the consequent failure? The story of Peter Palchinsky's life, and his ideas about technology and its social and economic contexts, provide an important piece of this puzzle.

The Worker Question

Like many young educated Russians at the turn of the century, Palchinsky was attracted to political doctrines that promised a better society than the authoritarian and poverty-stricken one in which he was born. He soon suffered for these beliefs. Even as a student at the Mining Institute in St. Petersburg he attracted the attention of the tsarist gendarmes, who listed him as a "leader of the movement" of radical students, evidently because he briefly chaired a students' assembly. This early political difficulty was a harbinger of many more in his life: he would be imprisoned five or six times and was under almost constant surveillance by the tsarist police and later by the Soviet secret police.

An important set of events in Palchinsky's early career occurred in 1901-1902, when the tsarist government assigned him to study a decline in coal production in Ukraine's Don Basin. As the youngest member of an investigative commission, Palchinsky was given the less prestigious task of looking into the "worker question" while the others studied mine operations. He began modestly by trying to gather some basic information. To his amazement, the operators of the mines knew very little about their workers, not even their total numbers or the number of worker-days annually expended in each mine. The owners also seemed uninterested in the workers' living conditions. Palchinsky decided to collect his own statistics.

He worked feverishly for more than two years, amassing an enormous quantity of information such as architectural drawings of workers' housing and maps of population density and transportation networks. At the Makarevskii Mine, he found barracks that housed 68 mine workers in a single room, with plank beds lined up in long rows of 20 or more and no space between them. Palchinsky often found families living four to six to a house, with an entire group in each room.

Palchinsky sent back his reports to St. Petersburg with neat summary tables and drawings and no political comment. At first the minister of finance and officials in the Ministry of Trade and Industry recognized the value of the work and even suggested that it be applied to other branches of industry. Gradually, however, the political significance of the reports began to dawn on these officials. When Palchinsky authored an article for the *Mining Journal* documenting some of his findings, the manuscript caused an uproar, and he was dismissed from the investigative commission.

Radicalized by these experiences, Palchinsky was drawn at first to the anarchism of Peter Kropotkin, a Russian revolutionary of noble lineage who at the end of the nineteenth century and beginning of the twentieth wrote influential books portraying the possibility of a new society without exploitation or oppression. Kropotkin's anarchism was of a moderate variety: instead of calling for violence, he spoke of "mutual aid" and the benefit that would come to civilization if it would reconstruct itself on the basis of autonomous associations of agrarian and industrial producers working peacefully and cooperatively. Mental and physical work would be combined under such a system, along with the advantages of both countryside and city.

Palchinsky was inspired by the fact that, in contrast to many utopians, Kropotkin considered technology a friend rather than an enemy. He believed that the Industrial Revolution of the eighteenth and nineteenth centuries was a cruel aberration in history, a temporary phase when financial capital and steam technology worked together to form an oppressive society based on centralized factories with division of labor and resulting class conflict. Kropotkin believed that in the near

LOREN R. GRAHAM is a professor in the Program on Science, Technology, and Society at MIT and author of Science in Russia and the Soviet Union: A Short History *(Cambridge University Press, 1993).*

future new technologies such as electricity and the telephone would lead to novel forms of work in agriculture and industry. The coming society would be heterogeneous, combining a few large enterprises with a multitude of autonomous smaller ones.

In the Revolution of 1905 Palchinsky did not join the anarchists' agitations and occasional robberies, but he did give his support to the revolution, was arrested as a result, and sentenced to exile in Siberia. There he continued to work as an engineer, and came to be valued by mine owners for his ability to improve productivity and reconcile differences between management and labor. By early 1908 he had escaped and made his way to Western Europe, where he began a new life that was to last for five years.

In Germany, France, England, the Netherlands, and Italy, Palchinsky became a successful industrial consultant and, perhaps more important, further developed an approach to his profession that he followed for the rest of his working life: he insisted on viewing engineering plans within their social and economic contexts. When Palchinsky's employers asked him to boost the productivity and efficiency of the world seaports of Amsterdam, London, and Hamburg, he advised them that improving operations was not simply a matter of providing cranes, rail spurs, deep sea channels, wharves, and warehouses; it was also a matter of workers' housing, schools, public transportation, medical care, recreational facilities, adequate pay, and social insurance. Workers could not effectively load or unload ships without the skills and commitment to do the job.

In 1913, when his eight-year Siberian exile would have ended, Palchinsky received a pardon from the tsarist government and returned to his native land, where he founded an institute devoted to the "study of the rational use of the natural resources" of Russia. Known as the Institute of the Surface and Depths of the Earth, it took as a slogan a thousand-year-old phrase from the founding document of ancient Kiev: "Our land is great and rich, but there is no order in it." Palchinsky announced that his goal was to achieve order not by inviting in foreigners, as the ancient Kievans had done with the Vikings, but by applying the methods of modern engineering to the problems of economic development.

During World War I Palchinsky served as deputy head of the government's War Industry Committee, where he began to see that centralized planning of industry, at least during wartime, had definite virtues. No longer did Kropotkin's emphasis on decentralization of economic activities seem as attractive, although he continued to admire Kropotkin's views on how technology could be made to serve the public interest. He considered himself a democratic socialist, and he favored the overthrow of the tsarist government for which he worked.

Thus after the downfall of the monarchy in 1917, Palchinsky was a strong supporter of the provisional government, seeing it as the best possible opportunity for the emergence of democratic government in Russia. He held several positions in the provisional government, including deputy minister of trade and industry, but later wrote that he was horrified by government leaders' lack of resolve, and he soon recognized the situation as hopeless.

IN HIS EARLY INVESTIGATIONS OF THE "WORKER QUESTION" IN COAL MINES, AND THROUGHOUT HIS CAREER, ENGINEER PALCHINSKY INSISTED THAT TECHNOLOGICAL PLANS BE VIEWED WITHIN THEIR SOCIAL AND ECONOMIC CONTEXTS. HERE HE IS SHOWN AT A MINING EXHIBIT HE ARRANGED FOR A TRADE FAIR IN TURIN, ITALY, IN 1911.

PHOTO: STATE ARCHIVE OF THE RUSSIAN FEDERATION

Revolutionary Dreams

After they seized power, the Bolsheviks arrested Palchinsky along with other officers of the provisional government, and he spent five months in jail. But in early 1918 the Bolshevik government began taking a more tolerant attitude toward "bourgeois specialists," whose help was needed in the economy and in the Civil War, and released several of them, including Palchinsky, from prison. Palchinsky at first had little sympathy with the Bolsheviks, who were, in his mind, usurpers of power, but gradually he and many of his associates found aspects of the new Soviet economic and political system beckoning. The Bolsheviks were committed to industrialization, and to science and technology. Perhaps he could work with the new rulers after all.

Palchinsky was particularly excited by the effort to electrify all of Russia within a few years, accepting the idea that a centrally planned socialist economy would be able to electrify much more rapidly than a capitalist one. He became a professor at the Mining Institute and worked as a consultant on a host of projects, including the building of the giant dam on the Dnieper River, the drafting of maps of population density and mineral deposits, the building of railroads and mines, and the construction of sea and river ports. Sought out by many government planning agencies, he quickly became one of the best-known engineers in Soviet Russia, chairing the Russian Technical Society and serving on the governing presidium of the All-Russian Association of Engineers. Throughout this period he traveled constantly, wrote many reports for government commissions, and everywhere championed the causes of mining and industry.

And Palchinsky continued to defend workers against managers. He observed, for example, that the managers of oil refineries talked too much about preventing theft and hooliganism and too little about protecting workers from fires and explosions. Despite such problems, he believed that socialist Russia had the opportunity to develop a far more humane industry than anywhere else. While Palchinsky admired American workers, for instance, he thought that industrial managers in the United States were too narrowly interested in profits, and that U.S. society in general was too self-centered.

Although Palchinsky praised the idea of central

Red Elephants

THE early Five-Year Plans and their industrialization projects, so celebrated in the Soviet Union and abroad, not only ignored the principles of Palchinsky and his colleagues but also betrayed the enthusiasm of the country's people who enrolled in the building of socialism. These projects were not of appropriate size, were not responsive to local conditions, and did not rank workers and local citizens as the highest priority.

Two monumental projects in the early Five-Year Plans entailed constructing the world's largest steel plant, along with the West Siberian city of Magnitogorsk; and digging, in record time, the White Sea Canal linking the Baltic and White Seas. These projects were characteristic of Stalin's industrialization policy, one that emphasized gargantuan projects over smaller ones, output above safety, technology above human beings, rigid centralized planning over local initiative, closed decision making to the detriment of critical debate, and, above all, a madly rushed tempo. Such a strategy was to last for the duration of the Soviet Union and pervade virtually every aspect of its citizens' lives.

THE STEEL CITY OF MAGNITOGORSK. In 1929 construction began on a massive complex of blast furnaces, open-hearth furnaces, and finishing mills that would eventually produce almost as much steel as all of Great Britain. The complex was built near the site of one of the country's richest iron deposits, known as Magnetic Mountain because of the disturbances it caused to the compasses of early explorers of the region. Actually a series of five hills, the Magnetic Mountain region was remarkable not only for the richness of the iron found there but also for the ore's accessibility. Building Soviet Russia's greatest steel mill next to this geological wonder seemed eminently reasonable.

But was this really the best location for such a large steel mill? In articles published in 1926 and 1927, Palchinsky complained that the Soviet government was moving ahead with plans for constructing enormous mining and refining operations in West Siberia, the Urals, and Ukraine without adequate studies of the local geology, availability of labor, economics of transportation, and difficulty of supplying proper housing for the work force. He noted that although everyone marveled over Magnetic Mountain's rich ore, no one had yet made a thorough study of the amount of iron it contained. It was quite possible that after a few decades the ore would be exhausted, yet the presence of the world's largest steel mill would require the costly hauling of ore from other regions.

Palchinsky pointed out that no coal was available near the projected city of Magnitogorsk, so that from the very beginning fuel for the voracious blast furnaces would have to be brought in by railway. He also noted that the region was not served by waterways, although water is by far the least expensive means of hauling heavy loads such as iron ore and coal. In countries such as the United States, he observed, steel mills are located not near the rich ore

IT WAS A FAILURE FROM THE START, BUT SOVIET PROPAGANDISTS STILL DECLARED THAT "THE WHITE SEA–BALTIC CANAL, CONSTRUCTED UPON THE INITIATIVE OF COMRADE STALIN, IS ONE OF THE GREATEST CONSTRUCTIONS OF THE FIRST FIVE-YEAR PLAN." SYMBOL UPON SOCIALIST SYMBOL, THIS 20-METER-HIGH SOVIET STAR WAS BUILT AT THE END OF THE LAST SLUICE BEFORE THE WHITE SEA.

deposits of the Mesabi Range in Minnesota or the Marquette Range in Michigan but hundreds of miles away in Detroit, Gary, Cleveland, and Pittsburgh—cities with large labor forces, the first three connected to the sources of ore by water and the last located near enormous coal deposits. The costs of building the city of Magnitogorsk and its mills could be so great, he maintained, that it might be wiser to expand steel production near less rich deposits of iron ore with better access to labor and transportation.

Palchinsky's worries about the location of Magnitogorsk were ignored. But by the early 1970s they proved correct: the mills had to import ore over land from distant regions, as they had shipped in coal for the blast furnaces. Magnitogorsk became a monument to inefficiency, yet it remains the largest producer of steel in Russia.

The White Sea Canal. This project not only ignored the engineering principles of Palchinsky and his colleagues; it also obscenely violated human rights. In the great project of the steel city of Magnitogorsk, prisoners worked alongside free laborers. Almost all the workers building the White Sea Canal, from the supervising engineers down to the lowliest laborers, were prisoners, toiling under conditions of unimaginable cruelty. Some 200,000 died during less than two years of construction, an average of 10,000 a month.

The goal of connecting the Baltic and White Seas was a dream dating from the time of Peter the Great, and Stalin viewed it as another symbol for the strength of socialism. But although he recognized the need for engineering expertise in completing such projects, his mistrust of engineers made him drastically limit their counsel. Thus the construction leaders of the White Sea canal were not permitted to question the wisdom of the project itself. Their analysis did not mention that the canal would be frozen half the year, and that modernization of the existing railroad, usable year-round, might be more sensible.

As prisoners, the engineers were allowed to submit suggestions to their police supervisors only for the path of the canal and the method of construction. They came up with two choices for its location. The "western variant," which they preferred, would be deep and have a secure supply of water, although it would take longer to build and require more dams and mechanized equipment. They feared that the water supply for the "eastern variant," largely dependent on snow runoff in the spring, would not be adequate, especially in years of light snowfall.

The engineers were told that the canal absolutely had to be completed in just 20 months, and that no mechanized equipment or concrete could be used, since that would require spending foreign exchange. The political vulnerabilities of these imprisoned "bourgeois specialists" made their position impossible: if they continued to defend the western path for the canal, they would be accused of trying to sabotage the project or of having economic loyalties to the capitalist West from which equipment would be purchased. Although they were already prisoners, they could be reassigned to the hardest manual labor, transferred to a prison elsewhere, or even executed. Against their better judgment, they assented to the eastern plan and threw themselves into supervising hundreds of thousands of prisoners employing the most primitive means of construction.

From the beginning the White Sea Canal failed to live up to its specifications. It was so shallow that even in years of the deepest snowfall oceangoing vessels could not use it. The transfer of large naval vessels, one of the justifications for the canal, was impossible. Within a few years the walls of the canal began to crumble and the lock gates to collapse.

After World War II the rebuilding of the entire canal began. In many places the new canal ran parallel to the first and so had the same water shortage problems, but at least it had better walls and metal gates on its locks. In 1966 Aleksandr Solzhenitsyn spent a summer day at the canal; during eight hours he saw only two barges pass, loaded with timber and going in opposite directions. The locks guards admitted there was little traffic. But the canal remained a prominent part of the folklore of Soviet industrialization nonetheless.■—*Loren R. Graham*

PHOTO: SOVFOTO/EASTFOTO

planning, he remained skeptical of commands that ignored local conditions and initiative, just as he criticized the tsarist government for importing from Western Europe stone for foundations and embankments that could have been obtained near at hand. Conditions on the spot, such as availability and costs of coal, water transport, educated workers, and construction materials, would lead to different solutions to problems that at first glance appeared similar. Whether to use wood or coal as fuel for steam engines on Soviet railroads should not be dictated from Moscow, he maintained; instead, fuel should be obtained locally according to price.

Palchinsky was also frustrated by the Bolshevik penchant for gigantic enterprises—the belief that the best facilities will always be the largest ones. True to Kropotkin's teachings, he lamented the ideology that considered small industry and artisans to be relics of the past, and he made a plea for a symbiotic mixture of all kinds of activities. A society where human needs are fulfilled, Palchinsky insisted, cannot be achieved without heterogeneity in scale, style, and organization.

WORKERS ENDURED THEIR UNMET NEEDS BY LOOKING TOWARD THE ROSY FUTURE PROMISED BY THE SOVIET REGIME. EVENTUALLY, THEIR NAIVE HOPES DISAPPEARED COMPLETELY. WHILE THIS BRICKLAYER AT MAGNITOGORSK IN 1931 ATE HIS MODEST MEAL, A POSTER BEHIND HIM DECLARED "WE ARE CONTINUING THE CONSTRUCTION OF THE FOUNDATION OF A SOCIALIST ECONOMY! THE BUILDING OF SOCIALISM IN OUR COUNTRY WILL BE CARRIED THROUGH TO THE FINISH!"

While in exile in Western Europe, Palchinsky had seen that small-scale operations were sometimes the most efficient, even in heavy industry. He wrote in 1911, for example, that the largest contributors in the British coal industry were not the largest mines (more than 1,000 workers) but middle-sized mines (100 to 1,000 workers): the latter produced 70 percent of Britain's coal while the former produced only 28 percent.

Palchinsky continued this line of reasoning as an adviser to Soviet industrial planners, noting that replacing machinery is often easier in small facilities. Supervision is usually simpler and more intimate, and workers at small and middle-sized plants are usually more successful in grasping the final goals of the enterprise. The entire staff of small plants, he concluded, usually feels organically interconnected.

Successful industrialization and high productivity were not possible, he repeatedly emphasized, without highly trained workers and adequate provision for their social and economic needs. He held that an investment in education promoted industrialization more than an equivalent investment in technical equipment, since an uneducated or unhappy worker would soon make the equipment useless. Concern for satisfying creative individuals' cultural and spiritual needs was not just an ethical principle but also a requirement for efficient production. The single most important factor in engineering decisions was human beings.

To achieve the goal of well-educated workers, Palchinsky proposed an expanded education system, financed by the government but supervised by engineering societies such as the Russian Technical Society. But the Soviet government did not see any reason for creating special schools outside the normal educational system and was suspicious of the engineering societies, many of whose members, like Palchinsky, were not affiliated with the Communist Party. Undeterred, Palchinsky fought hard—though unsuccessfully—for his educational ideas, even writing an appeal to the party leader Leon Trotsky in 1925, unaware that Trotsky's political influence was already beginning to wane.

Palchinsky also promoted an ambitious role for engineers. He wanted them to apply a new form of social

analysis to industrialization, and he believed that for this to happen the engineer's place in society must change. Rather than accepting a passive role solving technical problems, Palchinsky maintained, the engineer must emerge as an active industrial planner, influencing where economic development should occur and what form it should take. For example, an engineer asked to design a large hydroelectric dam should ask whether a dam is indeed the best way to obtain electricity. If coal is locally available, perhaps a thermoelectric plant would be a wiser choice. Answering the question depends on evaluating the economic, social, and environmental effects of each option.

But for all his sophistication about engineering, Palchinsky badly misunderstood the political course of the Soviet Union. His ambitions for engineers could be realized only in a society that granted the various professions a high degree of autonomy, and whose government was willing to listen to advice from outside official circles. As he was to discover, Stalin had a very different vision of society and of industrialization.

Palchinsky liked to say that a good engineer could not perform miracles, only the maximum within what was possible. Stalin, by contrast, promoted an ideological campaign for economic advancement that set wildly unrealistic goals requiring superhuman effort. He preferred that technological enterprises be the largest in the world—an industrial policy that Western observers later characterized as "gigantomania"—and he was quite willing to force poorly educated peasants from the countryside to perform new industrial tasks for which they were not qualified. The results were high accident rates and shoddy production, graphically described in memoirs of the period.

The relocated workers lacked adequate housing, especially for the winters. Their high death rate from exposure and disease was for Stalin an acceptable cost, but for Palchinsky it was a sign of irrationality, inefficiency, and injustice. More than a little irony exists in the professional engineer's call for attention to human needs over technology while the party leader emphasized technology above all else.

The most important source of conflict between the two was Stalin's mistrust of specialists educated before the Revolution. In Stalin's eyes these professionals harbored dangerous ambitions. While Palchinsky called for engineers to take an active role in politics, Stalin's opinion on this subject was revealed in an interview with H. G. Wells in 1934: "The engineer, the organizer of production, does not work as he would like to, but as he is ordered. . . . It must not be thought that the technical intelligentsia can play an independent role."

WORKERS BUILDING THE GREAT SYMBOLIC PROJECTS, SUCH AS THESE MEN DIGGING IN 1929 AT THE MAGNITKA HILL CONSTRUCTION SITE OF THE MAGNITOGORSK STEEL PLANT, TOILED LONG HOURS UNDER DIFFICULT CONDITIONS USING PRIMITIVE TOOLS. THEIR HIGH DEATH RATE WAS FOR STALIN AN ACCEPTABLE COST, BUT FOR PALCHINSKY IT WAS A SIGN OF IRRATIONALITY, INEFFICIENCY, AND INJUSTICE.

A Stunted and Narrow Education

After 1930 engineers in the Soviet Union turned away from the broad social and economic questions that Palchinsky believed were intrinsic to the engineering task. One reason, especially during the thirties and forties, was fear. Stalin made it clear to Soviet engineers that if they wanted to stay out of trouble, they must concentrate on the narrow technical tasks that party leaders assigned to them .

This pervasive fear caused engineers to stop raising questions—about workers' safety and housing, for instance—with

PHOTOS: LEFT: MARGARET BOURKE-WHITE; ABOVE: RIA-NOVOSTI/SOVFOTO

directors concerned primarily with meeting production quotas for their factories and mines. But even adhering closely to their assigned technical tasks did not guarantee that engineers would avoid political trouble, since their ability to increase output was constantly judged. Because a failure to meet quotas could become a "political" mistake in the eyes of the leaders of the local Communist Party organizations, many engineers tried to get out of production completely by fleeing to research institutes. An American historian who noticed this phenomenon called it "the flight from production."

Engineers also narrowed the definition of their work as responsibility for training was taken away from the Ministry of Education and turned over to the industrial ministries, whose educational institutions set restricted goals for their graduates. Professors at these technical colleges avoided touching on politics and social justice, concentrating instead on science and technology of the most specialized kind.

This system began to produce a new breed of engineer in great numbers—more engineers, in fact, than any other country in the world. With a strikingly circumscribed vision resulting from training even narrower than that of their colleagues in other countries,these engineers aimed only at increasing production, to the neglect of all other factors.

Students in Soviet engineering institutes did not major in mechanical or electrical engineering, for example, as in most other industrialized countries, but instead in one of hundreds of subspecialties. "Each commissariat sought to train its own staff in specialties so limited that they bordered on the absurd," notes Harley Balzer of Georgetown University. "The Commissariat of Light Industry included engineering specialties for the compressors in each type of machinery. The Commissariat of Heavy Industry insisted on separate engineers for oil-based paints and non-oil-based paints. The Commissariat of Agriculture trained agronomists for individual crops and veterinarians for each type of animal."

I discovered the effects of such specialization during my first visit to the Soviet Union in 1960 when, as a recent engineering graduate, I met a young woman who said that she was also an engineer. "What kind?" I asked. "A ball-bearing engineer for paper mills" was the reply. I responded, "Oh, you must be a mechanical engineer." She rejoined, "No, I am a ball-bearing engineer for paper mills." Incredulous, I countered, "Surely you do not have a degree in 'ball bearings for paper mills.'" She assured me that she did indeed have such a degree.

Engineering colleges in the fifties and sixties offered only three courses outside the technical curriculum: political economy, dialectical materialism, and history of the Communist Party. Palchinsky had suggested that all engineers be required to take a course in political economy, but what he had in mind was the study of the major economic theorists and the interactions of society and industry. What Soviet students received instead was an empty exercise in Marxist propaganda.

The course on dialectical materialism, centered on a sterile treatise on the "laws of the dialectic" in nature, soon became infamous among Soviet students as the most boring of their obligatory studies. And the course on the history of the Communist Party presented a severely distorted account of Russian and Soviet history, always depicting the Communist Party as the "vanguard of the proletariat" and the director of the country's destiny.

In sum, engineering students in the Soviet Union received a stunted and narrow education—intellectually impoverished, politically tendentious, socially unaware, and ethically lame. It would have been bad enough if students applied such training only in the factories and research centers, but most of the leading political figures of the latter-day Soviet Union shared this limited engineering background.

FROM 1908 TO 1913, PALCHINSKY WAS AN INDUSTRIAL CONSULTANT IN WESTERN EUROPE. HIS WORK AT SEVERAL MAJOR SEAPORTS ENCOMPASSED, AS ALWAYS, NOT ONLY ENGINEERING DESIGN BUT THE WELFARE OF WORKERS. THEY COULD NOT EFFECTIVELY LOAD OR UNLOAD SHIPS, HE INSISTED, WITHOUT THE SKILLS AND COMMITMENT TO DO THE JOB. HERE HE IS SHOWN AT HIS DESK, WHERE HE COMPLETED A FOUR-VOLUME STUDY OF SEAPORTS.

Knowing precious little about economics and cost-benefit analysis, not to mention sociology and human psychology, the country's top administrators continued to follow until the very end of the Soviet Union a socially blind policy of fulfilling plan goals without examining trade-offs and alternatives. Their enterprises were inevitably flawed in their approach to allocation of resources, environmental considerations, and social costs. Palchinsky would have considered them technicians, not genuine engineers.

A Humane Vision

By the late sixties and early seventies, invoking the ideological promise of a coming socialist utopia had become absurd. The erosion of Soviet citizens' faith accelerated as they became aware that their standard of living matched that of Third World countries. A great industrial power, the Soviet Union had become the world's largest producer of steel, lead, asbestos, oil, cement, and several other basic goods, but the cost in human and environmental terms of a blind fixation on output was perilously high. Food and consumer goods were often unavailable because political leaders insisted on producing steel for heavy industry and the armed forces. Life expectancy declined until the country ranked thirty-second in the world. Infant mortality rose until the country ranked fiftieth in the world. The environment was a disaster, especially around industrial cities like Chelyabinsk and Sverdlovsk, and in areas requiring irrigation, such as Central Asia.

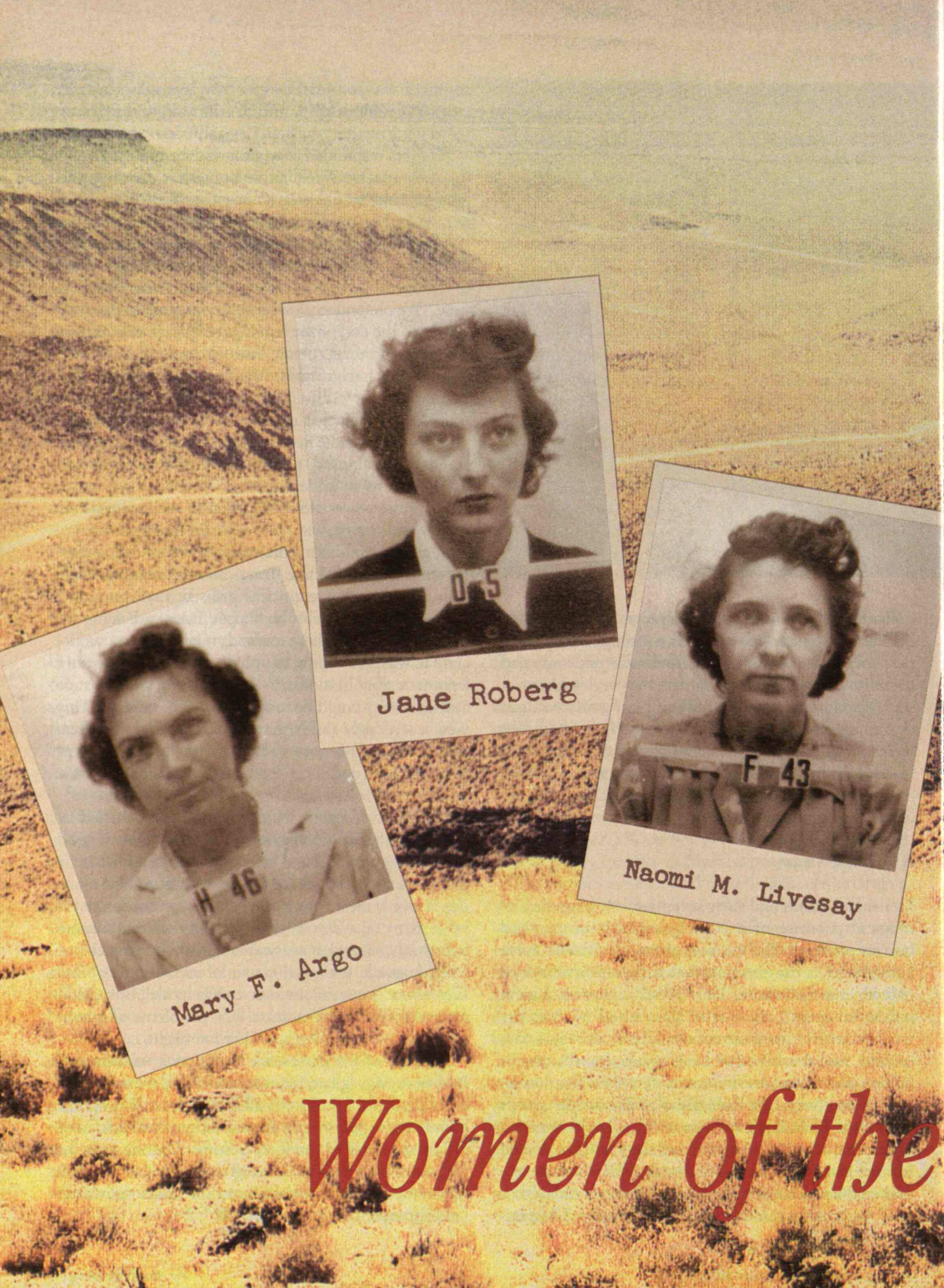
Workers responded to neglect of their needs by lapsing into apathy. Their naive hope that, in time, the Soviet regime would keep its promises took a long time to fade, but eventually it disappeared completely. In the waning years of the Soviet Union the attitude of the members of the proletariat, the supposed beneficiaries of communism, was expressed in the cynical observation, "We pretend to work and they pretend to pay us." Closer to the end of the regime, the phrase was revised to "They pretend to rule and we pretend to obey." Against this background, Palchinsky's advice that the "human factor" should be utmost in the mind of the engineer and manager was prescient. The gross neglect of its citizens by the Soviet regime was a primary reason that it collapsed so strikingly easily. In the end, it had almost no defenders.

Palchinsky's overlooked vision of technology and society, in contrast, was notable for its ethical sensitivity, even compared with technocratic doctrines being promoted elsewhere. While American engineers and their followers in other countries praised Taylorism and Fordism for their ability to boost efficiency, Palchinsky asked what effects these methods might have on workers. He was not willing to accept efficiency as the only legitimate goal of industry—in his vision, social justice and efficiency could be made to work in tandem. This view is strikingly similar to that of industrial managers who have recently tried to improve the productivity of assembly lines and shop floors by humanizing the work environment.

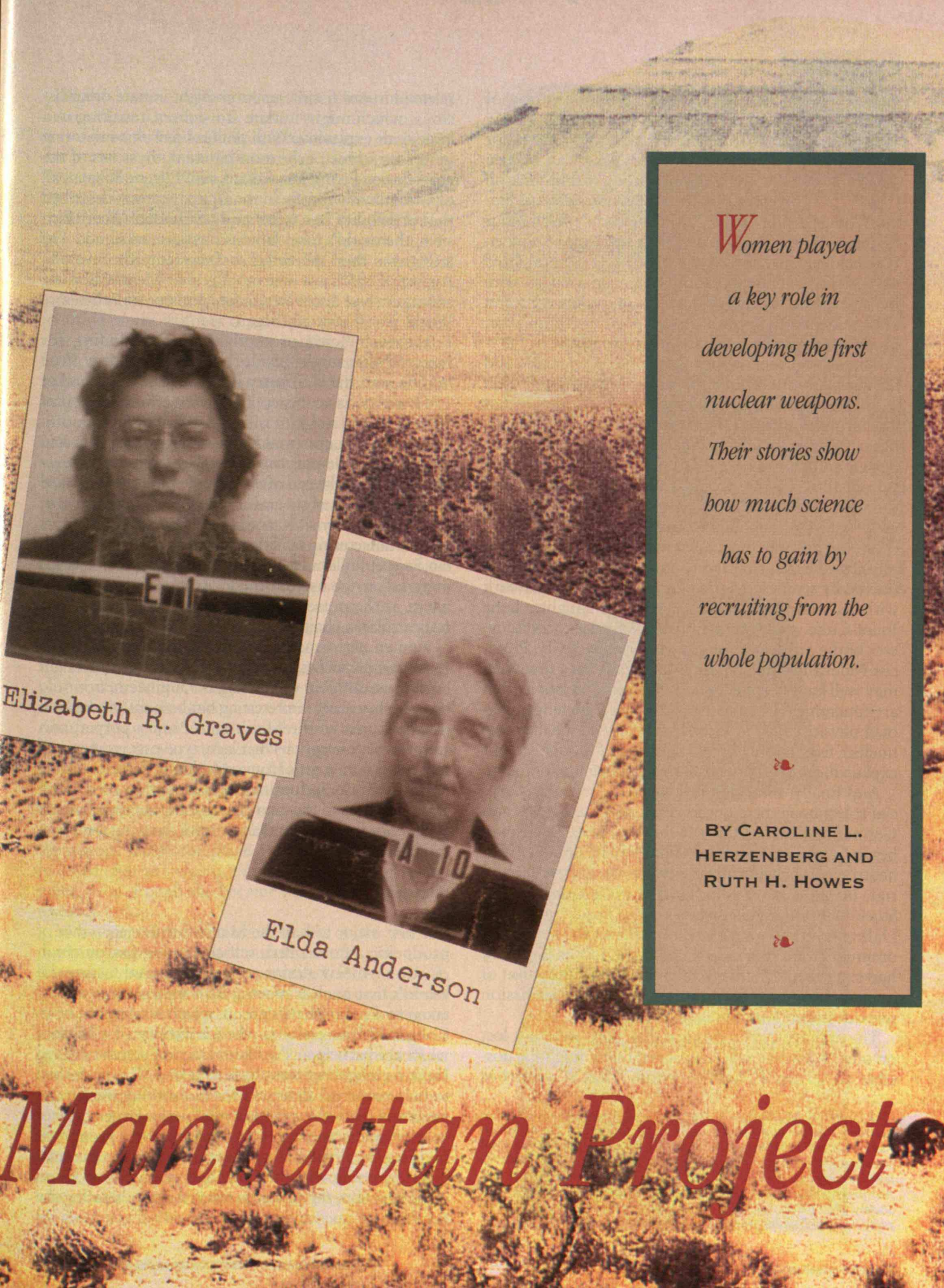
Palchinsky accurately predicted the harm caused by hasty industrialization projects that violated both good engineering practice and sound ethical standards. His questions about misguided industrialization continue to dog not only the former Soviet Union, casting doubts on what many regard as its greatest achievements, but also industrial civilization everywhere, from the steel city of Magnitogorsk, the failed garden of socialism *(see "Red Elephants," page 26)*, to its erstwhile model, Gary, Indiana, plagued with common U.S. problems of unemployment, poverty, drugs, and urban blight.

Because of his prescience, some may wish to call Palchinsky a prophet. Less convinced of the existence of revealed truth, I prefer to call him a ghost. That ghost haunts most pervasively the inefficient, polluted, and inhumane cities of the former Soviet Union, since his original criticisms were directed toward his native land, but it hovers uncomfortably over the industrial wastelands of other countries as well.■

PHOTO: STATE ARCHIVE OF THE RUSSIAN FEDERATION



Women of the



Manhattan Project

Women played a key role in developing the first nuclear weapons. Their stories show how much science has to gain by recruiting from the whole population.

BY CAROLINE L. HERZENBERG AND RUTH H. HOWES

AS THE LARGE-SCALE mobilization of young men into the military during World War II led to serious labor shortages at home, American women eagerly donned trousers and took on jobs that had previously been off-limits. Women doing "men's" work became the glamour figures of World War II posters. But some of the women who held unconventional jobs were never memorialized on posters. Among these were the female scientists who joined in all aspects of war research, including the secret crash research program—code-named the Manhattan Project—to develop the first nuclear weapons.

Widely regarded as one of the great scientific and technical adventures of all time, the Manhattan Project is still shrouded in secrecy, and some of its history, not least significantly the contributions of female scientists, has never been told. Although at least 85 women helped design and construct the atomic bomb, contributing significantly to the project's success, you can read through authoritative accounts of the program and never see a word about a woman.

Nor do histories often acknowledge how much of the physics research that led to nuclear fission was conducted by women. Marie Curie laid the groundwork with her study of radioactivity, and her daughter Irene Joliot-Curie was, with her husband Frederic, codiscoverer of the artificial production of radioactivity. Physicist Mileva Einstein-Maric, Albert Einstein's first wife, may well have helped develop the ideas of relativity that are fundamental to understanding nuclear energy. German physicist Ida Noddack first proposed the idea that nuclear fission—the actual splitting of atoms—might explain the results of neutron bombardment of uranium.

And finally, Lise Meitner played a particularly crucial role among the pioneers of nuclear fission. She and German colleagues Otto Hahn and Fritz Strassman began a series of experiments bombarding uranium with neutrons and chemically analyzing the exposed material. In 1938, after Meitner fled Nazi Germany for Stockholm, she and her nephew Otto Frisch interpreted Hahn and Strassman's latest results to show that the uranium atoms had indeed been split, just as Noddack had suggested. Meitner's theoretical interpretation of nuclear fission pointed out the key fact that fission releases stupendous amounts of energy.

The military implications of this work were not lost on other scientists, who speculated that it might be possible to set up a chain reaction. That is, neutrons released in one fission reaction might initiate other fissions, which might initiate still others, resulting in a large-scale explosion. With political tensions mounting in Europe, three of the most eminent physicists of the era—Enrico Fermi, Leo Szilard, and Eugene Wigner, all of whom by then were in the United States—described that possibility in a letter and persuaded Albert Einstein, the world's most famous physicist, to sign it. The letter was then delivered to President Roosevelt in August of 1939, just nine months after Meitner and her colleagues had discovered fission and one month before World War II officially began.

Roosevelt acted promptly to begin funding for research that might produce the world's first atom bombs, and the U.S. entry into the war in December 1941 was decisive in stepping up the effort. Soon after June 1942, the real start of the Manhattan Project, officials realized that it would have to develop rapidly into the largest single-purpose technological enterprise ever established. By the end of the war, the program consisted of experiments at several universities, work at three major laboratory sites, and a vast array of pilot plants and manufacturing facilities. Not only did the Manhattan Project build nuclear weapons, but it produced the materials to be used in them. And it also confirmed what, at the outset, scientists only suspected: that a nuclear-fission chain reaction could be made to occur.

Women performed research in all the above areas. As female physicists, we want to set the record straight on those unknown scientists and engineers, not only because their story is interesting but because its omission from histories of the Manhattan Project perpetuates cultural misconceptions that have type-cast women and prevented young girls from considering careers in such fields. With the technological competition the United States will face in the next century, we cannot afford to discourage half the population from studying the physical sciences.

Preparing the Way

The first major task of the Manhattan Project—that of producing a controlled, self-sustaining fission chain reaction—meant designing, building, and testing the world's first nuclear reactor. This mission was undertaken by Enrico Fermi's group, which was moved from Columbia University to the University of Chicago, where the participants worked under the stands of Stagg Field. Among them was physicist Leona Woods, drafted to help construct detectors for monitoring the flux of neutrons from the atomic "pile"—the large stack of graphite and uranium blocks from which the group was building the first reactor. These detectors were crucial in determining when the pile had produced a fission chain reaction, the first step toward demonstrating the feasibility of nuclear weapons.

CAROLINE L. HERZENBERG, a physicist at Argonne National Laboratory, is a fellow of the American Physical Society and the American Association for the Advancement of Science, as well as a former national president of the Association for Women in Science. RUTH H. HOWES is the George and Frances Ball Distinguished Professor of Physics and Astronomy at Ball State University and a fellow of the American Physical Society. Herzenberg and Howes are pursuing a major research effort to study the contributions that women made to the Manhattan Project.

PRECEDING PAGE: ID BADGE PHOTOS, LOS ALAMOS NATIONAL LABORATORY

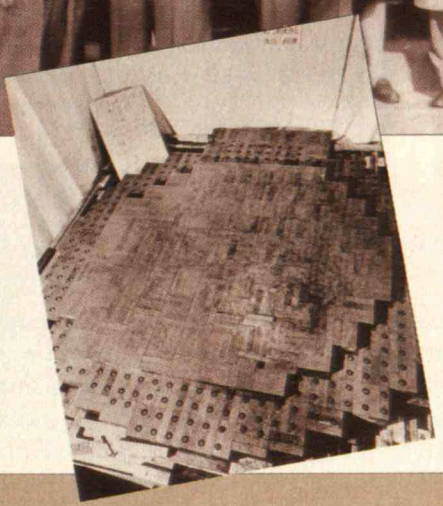
Woods was present when that chain reaction occurred, on December 2, 1942. After the atomic pile was dismantled and rebuilt in a remote area in the forest preserves outside Chicago for further research, Woods followed. When she became pregnant—she was by then married to physicist John Marshall—she continued to conduct experiments on the pile, hiding her condition under overalls and a denim jacket. She worked until two days before the birth of her first son in 1944.

Meanwhile, other Manhattan Project scientists were focusing on the isotopes capable of undergoing fission that would be used to build the bombs. Plutonium and U^{235} were being pursued simultaneously, and women helped meet the formidable scientific and technical challenges that both presented.

One difficulty with building a bomb based on U^{235} was that it required scientists to produce large quantities, perhaps hundreds of kilograms, of that rare lighter isotope of uranium. Not even a visible speck of it existed in pure form then. In some ways, the task was clear: U^{235} had to be separated from the much more abundant isotope U^{238}. Scientists knew they could not do this by chemical means and would have to use physical means. But no one had ever separated radioactive isotopes on a scale greater than microscopic. A range of potential separation methods had to be analyzed and evaluated.

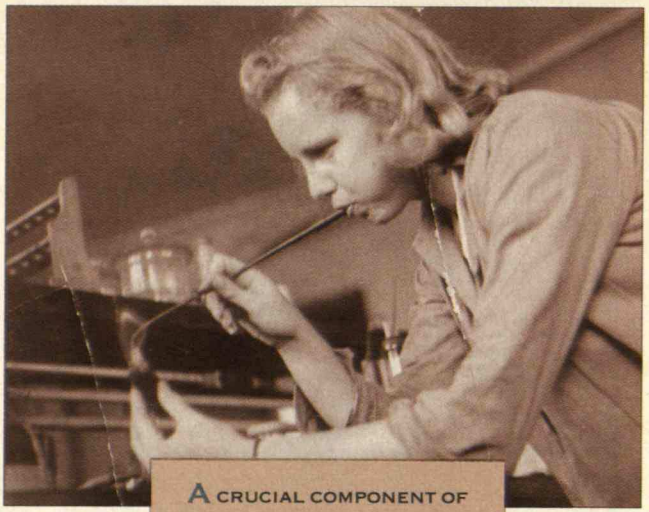
Maria Goeppert Mayer participated in the first stages of this work. Maria Goeppert grew up in Germany and studied physics in Gottingen, where she met and married Joe Mayer, an American who was also a student there. After they completed their degrees and moved to the United States, Maria Mayer faced the usual difficulties of female scientists in finding professional employment. A theoretical physicist, she was teaching half-time at Sarah Lawrence College when she joined the isotope separation project at Columbia University in 1942. But she was not given a full-time appointment, even though she became a senior member of a research group.

Mayer performed theoretical studies on the thermodynamic properties of the uranium hexafluoride gas to be used in one process for separating U^{235} from U^{238}. In this process, known as gaseous diffusion, molecules of uranium hexafluoride gas drifted through acres of nickel barriers riddled with pinholes, and the slightly heavier molecules containing U^{238} lagged behind those containing U^{235}. Mayer also investigated the possibility of using photochemical reactions for isotope separation, which turned out to be less feasible. Her later theoretical work focused on the energy a nuclear explosion emits as electromagnetic radiation, which, she noted, was enormous. Although these results were considered unimportant at the time, they provided the basis for designing the hydrogen bomb.



ON DECEMBER 2, 1942, THE FIRST ATOMIC REACTOR (ABOVE) PROVED THAT THE FISSION CHAIN REACTION NECESSARY TO CREATE A NUCLEAR WEAPON WAS IN FACT POSSIBLE. ON THE FOURTH ANNIVERSARY OF THAT OCCASION, THE SCIENTISTS WHO HAD BEEN PRESENT REUNITED AT THE UNIVERSITY OF CHICAGO (TOP). PHYSICIST LEONA WOODS MARSHALL, WHO HELPED CONSTRUCT DETECTORS TO MONITOR THE FLUX OF NEUTRONS, IS IN THE MIDDLE ROW. ON HER LEFT IS LEO SZILARD, WHO WAS KEY IN DEVELOPING THE IDEA OF THE CHAIN REACTION, AND IN THE FRONT ROW, FIRST FROM THE LEFT, IS ENRICO FERMI, WHO HEADED THE GROUP

PHOTOS: ARGONNE NATIONAL LABORATORY; UNIVERSITY OF CHICAGO ARCHIVES



A CRUCIAL COMPONENT OF THE BOMB WAS LARGE QUANTITIES OF ISOTOPES CAPABLE OF UNDERGOING NUCLEAR FISSION. PHYSICAL CHEMIST SUSAN CHANDLER HERRICK PARTICIPATED IN EXPERIMENTS THAT LED TO THE PRODUCTION OF ONE SUCH ISOTOPE, URANIUM-235, IN SUFFICIENT AMOUNTS.

Because secrecy was essential—and because the isotopic separation processes required large, complex facilities and huge amounts of electricity—the Clinton Engineer Works was built on a large tract of land along the Clinton River in eastern Tennessee, in the Appalachian outback. The methods of separation eventually developed and put into use there included gaseous diffusion and electromagnetic separation, in which uranium atoms are ionized and then move through magnetic fields—the lighter U^{235} ions tend to be deflected more by the magnetic fields, thus becoming separated from U^{238} ions. Many women participated in the scientific work supporting these isotope separation projects in Tennessee. One was Susan Chandler Herrick, who had studied physical chemistry with Maria Mayer and secured a job in the Manhattan Project through her influence. Herrick had worked in Mayer's group on problems in uranium chemistry, which included synthesizing and crystallizing compounds of uranium that might be of interest to the separation project, and developing techniques to produce single crystals of U^{235} from a few hundreds of milligrams. Herrick contributed to the development of improved nickel barriers for the gaseous diffusion plants used at the Clinton Engineer Works.

The research and development directed toward building a nuclear bomb based on plutonium also required complex facilities. As plutonium, which is not a naturally occurring element, had to be created artificially, large reactors were built for this purpose in an isolated area of the state of Washington that became the Hanford Engineering Works, or Hanford Reservation. Leona Woods Marshall, who had worked on the first nuclear reactor, moved to Hanford to join her husband in overseeing the operation and construction of the plutonium production reactors. Physicist Jane Hamilton Hall, employed first at the Metallurgical Laboratory at Chicago, became a senior supervisor of the reactors under construction.

Another woman who played a vital role in developing the plutonium production reactors was the metallurgist Nathalie Michel Goldowski. Born in Moscow in 1908 to parents who were part of the Russian aristocracy, Goldowski escaped with her mother from the Russian Revolution in 1917. She went on to receive a doctoral degree in physical chemistry from the University of Paris and then worked for the French Air Force, where she became chief of metallurgical development at age 32. When Hitler occupied France, she again escaped, this time to the United States, where she joined the Manhattan Project in 1943.

Metallurgy, Goldowski's specialty, was central to learning how to deal with the unfamiliar metals uranium and plutonium. Uranium presented a particular problem at Hanford: slugs of uranium had to be used inside the reactors as the raw material for plutonium production, yet it corroded quickly if exposed to the cooling water. Goldowski, who had previously developed innovative solutions to corrosion problems for aluminum and aluminum alloys, was able to address the corrosion dilemma on several fronts; she contributed to defining the necessary purity requirements on cooling water for the reactors, and she helped develop multilayered metallic canning of the uranium. This new canning method made it possible to maintain effective separation of the uranium and the coolant while providing for good thermal transfer between them. Her work enabled plutonium production to proceed at Hanford.

Other female physicists played important roles in solving an equally vexing problem that became apparent in September of 1944, when the first plutonium production reactor at Hanford was turned on and within hours turned itself off: the nuclear chain reaction tended to cease when a reactor was operated at high levels of neutron flux, as was necessary for the production of plutonium. Understanding this dilemma, which turned out to be caused by absorption of neutrons by one of the byproducts of fission, took several months and was perhaps one of the more exciting scientific accomplishments of World War II. The women who had a hand in it include the distinguished experimentalist Chien-Shiung Wu, whose knowledge of the nuclear properties of

noble gases proved invaluable—it was an isotope of xenon, one of these rare gases, that was absorbing the neutrons. Katherine (Kay) Way, who had helped analyze data from the earliest atomic piles, and who had done theoretical work on reactor design that was used in building the production reactors at Hanford, contributed a wealth of expertise as well. Way worked on evaluating reactor constants—the parameters used in defining the probabilities of the various processes that together determine reactivity and thus are necessary to calculate reactor characteristics. She also collaborated with Eugene Wigner on the Way-Wigner formula for calculating the amount of heat that fission products will generate in a given period after reactor shutdown.

Contributions at Los Alamos

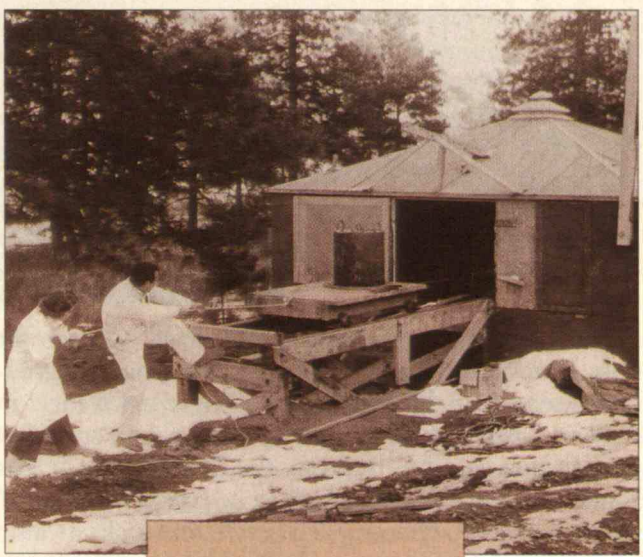
Before 1943, work on the design and functioning of the bombs was largely theoretical, based on reactor experiments. But in that year a new laboratory specifically for designing and building the weapons was established on an isolated mesa at Los Alamos in New Mexico.

Many women, some with degrees in mathematics or physics and others with little technical background, helped perform the extensive calculations needed for the design of the first nuclear bombs. Naomi Livesay, who had a degree in mathematics and experience in using electric calculating machines in the analysis of survey data, was typical. In 1944 she began work at Los Alamos as an assistant scientist and soon was supervising a team using electric calculating machines to track the blast wave of the conventional explosion through the fissile material at the core of the bomb, and then track the shock wave of the fission detonation back out. Because these calculations were so critical they were done under extraordinary time-pressure, in 24-hour shifts 6 days a week.

Physicist Ella Anderson worked at Los Alamos on questions about the fission process, such as how many neutrons are produced per fission. She also prepared the first sample of nearly pure U^{235} for use in experiments at Los Alamos. Mary Argo, a theoretical physicist, worked with Edward Teller's group, which was investigating the possibility of building a weapon based not on nuclear fission but on nuclear fusion. Theoretical physicist Jane Roberg contributed calculations for the fusion weapon as well.

Testing the explosives was one of the most important aspects of the Los Alamos work. Frances Dunne, an aircraft mechanic at Kirtland Air Force Base, was recruited by George Kistiakowsky as an explosives technician because her manual dexterity and small hands enabled her to adjust the trigger in the high-explosive shell of model weapons. She and her group tested various configurations of the conventional explosives assembly that would be used to detonate both Fat Man and Little Boy. They also composed the assembly crew for the world's first nuclear explosion, code-named Trinity, which took place at the Alamogordo Bombing Range in a desert area of south-central New Mexico on July 16, 1945. The bomb was a plutonium weapon with a reported yield of 15 to 20 kilotons.

Among the scientists assigned to monitor the Trinity test was Elizabeth Riddle Graves, a young nuclear physicist who had earned her PhD from the University of Chicago. Her first task at Los Alamos had been to help determine what kind of neutron reflector should surround the core of the bomb so as to scatter neutrons back into the fissioning core—she was one of the few physicists in the country with the necessary background. At the time of the Trinity test she was pregnant, so she conducted radiation monitoring off-site, focusing on the airborne plume of radioactivity. She and her husband checked into a cabin in a tourist court in Carrizozo, N.M., about 40 miles east, with a short-wave radio, a portable electric generator, a seismograph, and a Geiger counter. They watched the Geiger counter go offscale as the radioactive cloud passed over the small town after the explosion.



IN THE EARLY YEARS OF BOMB DEVELOPMENT, METHODS OF HANDLING RADIOACTIVE MATERIAL WERE PRIMITIVE AND "EQUAL OPPORTUNITY," AS IS CLEAR FROM THIS PHOTO OF AN ANONYMOUS MAN AND WOMAN WORKING AT LOS ALAMOS.

PHOTO: LOS ALAMOS NATIONAL LABORATORY

Trying Times at Oak Ridge and Beyond

By Beth Horning

THE Manhattan Project may have created opportunities for female scientists and technicians, but the attitudes that would drive many of these same women out of the work force at the end of the war were nonetheless in evidence. Ellen Cleminshaw Weaver, who worked as a chemist at Oak Ridge, points out that in her own case, one needed to look no further than the pay scale.

"I was paid 70 cents an hour, which was low even in those days. It was insulting," she says. "And I got docked an hour's pay if I was as much as one minute late." By contrast, men with her qualifications were paid a salary rather than an hourly wage, and ended up taking home roughly twice what she did.

Weaver learned that two other women she worked with were in the same boat, and when she decided to protest on behalf of both them and herself, she met with immediate resistance. "My superior told me, 'Look, this is the way it is, and if you don't like it, you can quit,'" she remembers. "Everyone thought women should be grateful just to be allowed to work. Equal pay was a completely foreign concept."

But Weaver persisted, taking her protest up the chain of command until she reached the chief honcho—the president of Monsanto Chemical Co., which ran the section of Oak Ridge where she was employed. She recounts that she was in and out of his office in about two minutes. "There I was, quite young, quite junior, newly hired and complaining about my pay. My palms were all wet. But he said that yes, the situation was obviously unfair. He said, 'You can stop punching the time clock today. We'll put you on salary immediately, and the two other women, too.' And that was the end of the interview."

Sadly, however, it was not the end of the story. "When it was time for me to pick up my paycheck that month, I got nothing but a big pile of pink slips that said, 'Why didn't you punch in?' and 'Why didn't you punch out?' So I went to the same man and he told me he had taken the matter to the U.S. Army, which had refused to okay a salary for me and the other women because it would amount to too big a raise."

After the war, Weaver went on to experiences in academia that were even more disheartening. By that time, she had developed an interest in biology as well as a realization that she would not be happy spending her life as a technician, which was all she'd ever be able to do with her bachelor's degree in chemistry. "I came to the conclusion that I just had to be in a position where I could make the decisions and ask the scientific questions," she says. And then something unprecedented happened: she met a woman with a PhD in biochemistry. "A lightbulb went off in my head. I thought maybe I could get a PhD myself."

So Weaver applied to the University of California at Berkeley in biology, was accepted, and enrolled. But she rceived little encouragement, save from her husband and one or two exceptionally kind professors. "This was the early fifties and there was a strong feeling that women should be at home," she says. "The general attitude of the family and other people was, 'Well the war's over, so why are you bothering with this?' One particular problem was that I had a thesis adviser who was ex-

THE DISCRIMINATION AGAINST WOMEN THAT BECAME SO RAMPANT AFTER THE WAR LURKED RIGHT BELOW THE SURFACE DURING THE MANHATTAN PROJECT, AS ONE WOMAN'S EXPERIENCE SHOWS.

Joan Hinton, another young physicist, got a closer look. Los Alamos had recruited Hinton from her graduate research at the University of Wisconsin early in 1944 and assigned her to a group headed by Fermi that worked in a canyon, building the first reactor at Los Alamos and the first anywhere to be fueled by material enriched in U^{235}. Hinton piled beryllium blocks around the spherical reactor core, designed and constructed control rods, and built electronic circuits.

She and the other graduate students in her group were not invited to view the Trinity test, but they knew when and where it would take place and sneaked in to observe it from a low hill about 25 miles from ground zero. Dodging the army guards in jeep patrols, Hinton rode to the mound at sundown on the back of a friend's motorcycle. The students waited all night as the detonation was delayed past the midnight target hour because of thunderstorms. Just before dawn, they witnessed the amazing heat and light of the world's first nuclear explosion. In Hinton's words, "It was like being at the bottom of an ocean of light. We were bathed in it from all directions. The light withdrew into the bomb as if the bomb sucked it up. Then it turned purple and blue and went up and up and up. We were still talking in whispers when the cloud reached the level where it was struck by the rising sunlight so it cleared out the natural clouds. We saw a cloud that was dark and red at the bottom and daylight at the top. Then suddenly the sound reached us. It was very sharp and rumbled and all the mountains were rumbling with it. We suddenly started talking out loud and felt exposed to the whole world."

After the War Was Over

Weeks later, a bomb based on the fission of U^{235} was dropped on Hiroshima, and then, a few days after that, a plutonium bomb was dropped on Nagasaki. The war came to an end. Some of the Manhattan Project scientists, including Joan Hinton, were shocked by the destructive force of nuclear weapons and became active in the movement to internationalize atomic energy for peaceful purposes. Because women were not allowed

tremely negative and told me that no woman out of his department had ever amounted to anything." Further aggravating her relationship with this adviser was her decision to have children while working toward her degree. "He was appalled. He would have nothing to do with me, especially when I became pregnant the second time." He didn't even attend her orals.

Weaver wound up failing the test—she took it too early in a desperate attempt to finish the program as soon as possible—and that was when she thought it might be best to just throw in the towel. "I mean you love science," she recalls, "but it's a lot of pain and conflict, and I thought maybe I wasn't smart enough." The primary reason she continued was that her husband was supportive. "He said, 'You've got too much invested in this. Go back and try the orals one more time.' And I did, did well, and I got through the doctorate." She also had a third child, who was born soon after the end stage of her degree work.

Though the rest of her career was hardly smooth sailing—she encountered not only discrimination but, on more than one occasion, sexual harassment—Weaver did become well respected in her field, publishing about 30 papers on photosynthesis and related subjects. When she retired last year, she was teaching biology at San Jose State University. She was also the national president of the Association for Women in Science (AWIS), an organization based in Washington, D.C., with nearly 5,000 members and more than 50 chapters. She will retain the post until January 1994.

Weaver asserts that AWIS, whose goal is to help women realize their ambitions in science, fills a real need—she is unimpressed with the progress toward accepting women that scientific institutions have made on their own. "When you look at boards of directors, deans of medical schools, deans of colleges of science, there are very few women," she notes. She says that one of the most effective steps those institutions could take to remedy the matter would be to abandon their rigid ideas about qualifications. For example, when organizations are trying to fill a leadership position, they may stipulate that they won't consider anyone who has never been a dean or a department head. "This automatically excludes a lot of women, because women have been kept out of those jobs. A better idea would be to interview in depth and give credit to candidates who have been innovative or shown themselves to work hard, learn quickly, and get along with people. The female talent is there, but the men in charge need to be creative about tapping it. And they also need to make sure the newly appointed women have continuing support."

BIOLOGIST AND MANHATTAN PROJECT VETERAN ELLEN CLEMINSHAW WEAVER IS PRESIDENT OF THE ASSOCIATION FOR WOMEN IN SCIENCE, WHOSE GOAL IS TO HELP FEMALE SCIENTISTS FURTHER THEIR CAREERS.

She adds that if the scientific establishment adopts this approach, science itself is likely to change for the better. "The flexibility that institutions must develop to help women advance their careers in science is bound to attract a range of people—male and female—who are willing to be unconventional." Such people are the ones most inclined to ask interesting questions, she remarks. And in science, "the questions you ask are enormously important."■

BETH HORNING is an associate editor of Technology Review.

to study graduate-level physics at the University of Illinois, Hinton could not complete her PhD there with her friends from Los Alamos, so she accepted Fermi's offer of a position at the University of Chicago. But after two years she became so repulsed by the militarization of American science that she emigrated to China, where she still works today as a designer of dairy farms.

The other women tended not to stray so far from their origins. Some went on to complete their degrees, some took university positions, some continued their work in the national laboratories. A few attained distinction. For example, Maria Mayer, who taught at the University of Chicago and worked at Argonne National Laboratory, developed the theory of nuclear structure known as the nuclear shell model, for which she was awarded a Nobel Prize in physics. Jane Hamilton Hall went on to do physics research at Los Alamos and eventually became associate director of the laboratory. She also was a long-time member of the General Advisory Committee of the Atomic Energy Commission.

But many of the women who had worked on the Manhattan Project dropped out of science. As men returned from the armed forces and began looking for civilian jobs, women found they had worn out their welcome in the labor force. The propaganda machine that at the beginning of the war had made work seem glamorous now discouraged women from jobs and careers and pushed them back into the home. The disincentives were such that even some of the most gifted and accomplished women abandoned scientific and technical work.

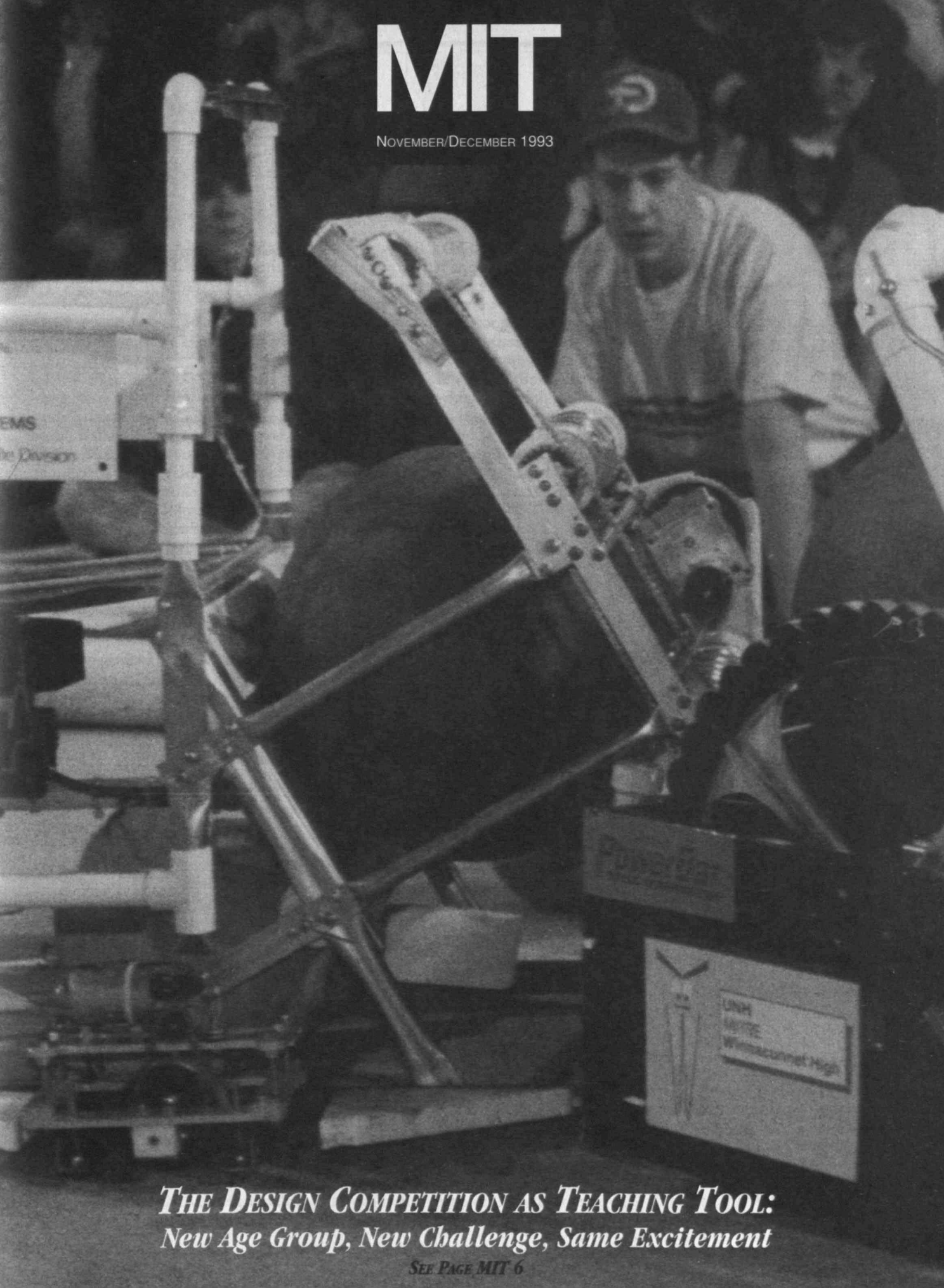
After earning a master's degree in chemistry from Columbia University and working for two years as an organic chemical analyst, Susan Chandler Herrick began to stay at home when the first of her four children was born. Eleanor Eastin Pomerance, who had worked as a technician at both Lawrence Radiation Laboratory and Oak Ridge, became a draftsperson at Oak Ridge, where she designed the three-bladed magenta and yellow fan that symbolizes radioactivity, but then retired for maternity. She went on to design jewelry, theater props, and masks as a hobby.

SOME OF THE FEMALE PHYSICISTS WHO WORKED ON THE MANHATTAN PROJECT WENT ON TO ACHIEVE DISTINCTION AFTER THE WAR. CHIEN-SIUNG WU (ABOVE) LED A COLUMBIA UNIVERSITY TEAM RESPONSIBLE FOR SHOWING THAT ALL SUBATOMIC PARTICLES DO NOT SPIN IN ONE DIRECTION. MARIA GOEPPERT MAYER (FAR LEFT) WON A NOBEL PRIZE FOR DEVELOPING THE THEORY OF NUCLEAR STRUCTURE KNOWN AS THE NUCLEAR SHELL MODEL. JANE HAMILTON HALL (LEFT) BECAME ASSOCIATE DIRECTOR OF LOS ALAMOS NATIONAL LABORATORY.

Among the women who performed the mathematical calculations for the design of the bomb, Eleanor Ewing Ehrlich, Betty Inglis, Kay Manley, and Mici Teller all returned to roles as wives and mothers. Naomi Livesay married Anthony French, a British physicist, and early in her marriage she worked on establishing a computer link between Harwell and Teddington in England, even though her salary was 30 percent below that which would have been paid to a man for the same job. She left to have the first of her children. Some years later, when she and her husband were back in the United States and she was offered a teaching position, she found that after paying childcare expenses, which were not tax deductible for women as they were for men, she would retain very little of her salary. She gave up the attempt to pursue a career in mathematics.

During World War II, women scientists had their day in the sun and demonstrated their technical ability. Their roles in the Manhattan Project were almost as widely varied as those of men, and they made significant contributions to the development of nuclear energy and nuclear weapons. But unfortunately, the post-war era showed that even capable women will leave science if they are strongly discouraged. To resist the post-war barrage of cultural messages to find fulfillment solely in the home took a degree of fortitude, independence, self-confidence, luck, and sheer love of science that men rarely, if ever, have to possess; it should hardly seem surprising that few women had it. In fact, many of those who did—like biologist and Manhattan Project veteran Ellen Cleminshaw Weaver (*see sidebar*)—attest to how worn down they felt, and how seriously they themselves considered quitting. If industries, universities, and national laboratories seriously hope to remove obstacles to women's full participation in science, they must absorb this lesson of how easily talent can go to waste. ■

PHOTOS: BETTMANN ARCHIVE; LOS ALAMOS NATIONAL LABORATORY



MIT

NOVEMBER/DECEMBER 1993

THE DESIGN COMPETITION AS TEACHING TOOL:
New Age Group, New Challenge, Same Excitement

SEE PAGE MIT 6

MIT
NOVEMBER/DECEMBER 1993

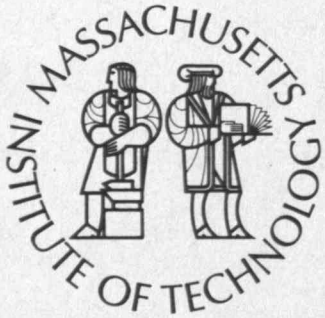
COVER:
As a team member watches intently, the last free kickball is captured by the "Dallas Road Runner" (center) in the tense final moments of the 1993 US FIRST high school design competition, which involved a number of MIT faculty, students, and alums. A video of the contest will be available in December to some 12,000 schools nationwide over the Classroom Channel. At press time, 40 schools were already registered for the 1994 competition, and US FIRST organizers expect that the television exposure will enable them to more than double from the 25 teams that participated in '93.
Photo from the Associated Press

LETTERS

MIT SEAL IN NEED OF REVAMPING?

MIT's seal has undergone several changes over time, one of which was an official modernization progression that included the elimination of the podium—and thus the "1861" sign—between the two figures. Another was the popular variation by Don Hatfield, '60, [originally appearing on the back of a "Four-year bill" created in 1957] featuring *Hamus et Eggus* replacing *Mens et Manus*:

Recently, I was scanning several logos to use on a dinner folder when Provost Mark Wrighton visited the MIT Club of Belgium. I noticed, after all these years, the rather unfriendly stance of the two figures, one representing the arts and the other science. Rather pointedly they stare in opposite directions, completely ignoring each other, like this:



I thought that MIT was indeed promoting the union of the technical and cultural aspects of our society. So through the "miracle" of computer manipulation, I've slightly rearranged the seal to show a more amicable pose of the arts and science, like this:

There is precedent for such a change in U.S. currency and seals: a few dozen years ago the American eagle, which holds symbols of war and peace in its claws, was rearranged to face toward the peace symbol. I think it's time for MIT to introduce a new cordiality between the arts and science by redesigning its monogram.

LESTER A. GIMPELSON, '57
Brussels, Belgium

Warren Seamans, director of the MIT Museum, responds: The image that Mr. Gimpelson refers to as "an official modernization progression" is in fact a special seal designed for the inauguration of President Howard Johnson in 1966. And although this and many other adaptations are (unfortunately) still in use, there is only one "official seal":

Even before the first classes had begun in 1863, President Rogers commissioned an engraved seal for the Institute. As MIT alumni/ae know so well, Mens et Manus *translates literally as "Mind and Hand." The scholar and the worker on either side of the altar symbolize the union of knowledge with the mechanical or manual arts (arts used here in the 19th-century meaning).*

Politics Intrigues at MCP Reunion

June 1993 wasn't a special anniversary for MIT's Master of City Planning (MCP) program, but graduates from the classes of '81 through '85 had a reunion nonetheless. The gathering owed much to the organizational initiative of Sylvia Watts McKinney, MCP '83. Better at keeping up with her former classmates than they were at keeping up with each other, McKinney spent a lot of time over the years answering inquiries from "A" about what "B" was doing. She decided it was time to offer her contemporaries a chance to update themselves directly on each other's lives and the state of their profession, so she enlisted the help of the Graduate Alumni/ae Program in putting together a reunion.

Reunion organizers had every reason to suppose that once the planners were assembled, getting a discussion going would be no problem. Passionate talk has gone with the territory ever since they were students. Mark P. Cullinan, MCP '83, remembered that his colleagues were always so involved in intense conversations that his study group didn't settle down to the assigned task until two or three hours after the scheduled time.

Centerpiece of the gathering was a panel of planners discussing a thread that ran through everyone's professional life: politics. Panelists included Cullinan, who is chief engineer for the Massachusetts Department of Environmental Management; Kari J. Moe, MCP '82, chief of staff for Senator Paul D. Wellstone (D-Minnesota); and Russell Tanner, '83, MCP '83, manager of housing development for the Community Builders in Boston.

"Pulling together the fabric of communities" that were neglected during the economic boom of the 1980s is the way Tanner describes his work with Community Builders—a nonprofit corporation that collaborates with grassroots organizations to initiate, finance, and manage affordable housing and commercial properties. Tanner, who worked in construction before attending MIT, said he "fights a general prejudice against low-income housing." Within two years of receiving an SB and MCP from MIT, Tanner was developing housing for the elderly, then he had a brief stint in policy and advocacy work before taking his current post.

He and other panelists agreed that diagnosing community needs and designing programs and facilities that meet them is not the hard part of their jobs. What *is* tough and time consuming is the politics of marshalling resources, something for which he felt he had not been trained. Tanner was uninclined, however, to blame MIT's curriculum for that lack: "I don't know if politics is not very teachable or if I was not mature enough [as as student] to recognize it," he said.

Boston Politics Was a Wake-up Call

After completing an undergraduate degree in civil engineering at the University of Massachusetts-Amherst, Mark Cullinan also found work in Boston, as an engineer for the city. One of his first assignments was on a working group reviewing proposals to build a hotel on the Boston waterfront. The group spent some 60 hours over a one-month period rating all the bids. Cullinan's first lesson in political reality came when then-Mayor Raymond Flynn announced at a news conference, without warning, that he had chosen the Marriott Hotel for the site, a proposal that the working group had ranked *last*.

In his previous posts, Cullinan saw animosity between planners and engineers. "At the beginning of a project," explained Cullinan, "the stress is on planning, not hard-core engineering issues. The engineers don't understand what's going on. [Then] the planning document is sent on to engineering, and the planners are suspicious that the engineers will change things." He has been breaking down the barriers between the disciplines at the Department of Environmental Management by assigning—right from the beginning—a planner, an engineer, and a contract administrator to every project under his authority. This team approach, he says, has given all the players a better appreciation of their counterparts' contributions. Cullinan believes that the traditional wall between the disciplines could eventually be broken down altogether if academic planning and engineering departments teamed up to prepare their graduates to work collaboratively.

As the chief of staff for Senator Wellstone, Kari Moe had the advantage of knowing from day one that building political consensus was central to her job. "Since the vast majority of planning issues are both technical *and* political," Moe said, "technical analysis is not enough. With each issue, you need to identify the best policy solution and factor in who gains and who loses, who will support you and who will be against you."

The comments on the need for political savvy were well taken, Professor Phillip L. Clay, PhD '75, said later, and the department is pursuing efforts that will increase students' exposure to the politics of their profession. Clay, who is the head of the Department of Urban Studies and Planning, said that more than half of the MCP students complete an internship at some point in their program, which is one way to gain experience at the interface of planning and politics. The MCP program also includes case materials that simulate political situations, Clay said, and students participate in studios and workshops that have real clients and faculty-student teams. Best of all, of course, would be for students to gain some direct knowledge of political realities before they begin their studies.□

—Stephanie V. Grepo

The author is the program manager of the Graduate Alumni/ae Program.

MIT Clubs Are Alive and Well and Awaiting Your Membership!

Across the nation and around the world, MIT Alumni/ae Clubs draw thousands of alumni/ae, parents, students, and friends to a broad range of social and educational activities. Since MIT clubs reflect the diversity of our alumni/ae body, events range from faculty speakers to career workshops, from plant tours to opera, all in an effort to promote the Institute and provide enlightenment about its programs. In addition, a number of clubs have a public service entity in which one may find people tutoring high school students or painting a shelter for battered women.

Club leadership is drawn from local alumni/ae volunteers who serve as officers or board members and who often rise to positions on Alumni/ae Association national boards and committees. Each club sends out annual membership invitations, usually with their first fall event announcement. If you haven't received your invitation yet, respond now by looking up the club president or alumni staff person in your area on the following list.

We look forward to seeing you soon and often at MIT Club activities, and we welcome your support.

Janet Serman

Janet Serman
Associate Director
MIT Alumni/ae Association
77 Mass. Ave., Room 10-110
Cambridge, Mass. 02139
(617) 253-8242
(617) 258-7886 (FAX)

REGIONAL DIRECTOR

Louis Alexander
(617) 253-8244
LALEXAN@MITVMC.MIT.EDU

ATLANTA
Contact Regional Director
Louis Alexander
(617) 253-8244

AUSTIN
Maureen M. Alexander '74 LI
(512) 443-2046 (B)

COLORADO
M. William Dix Jr. '71 CP
(303) 930-4115 (B)

DALLAS
Michael G. Weiss '65 ML
(214) 349-7066 (B)

NEW ORLEANS
Alan H. Katz '75 EE
(504) 585-7673 (B)

OKLAHOMA
Newton Agrawal
(405) 524-5227 (B)

RESEARCH TRIANGLE
Alan W. Yueh '86 EE
(919) 254-5976 (B)

SOUTH TEXAS
Alan Cisar '73 CM
(409) 693-0017 (B)

VIRGINIA
Albert M. Bottoms MT 62
(804) 296-3080 (H)

WASHINGTON, D.C.
Ramon C. Barquin PO 74
(202) 797-7800 (B)

SR REGIONAL DIRECTOR

Robert Blake HM
(617) 253-8243
RBLAKE@MITVMC.MIT.EDU

CENTRAL OHIO (Columbus)
Calvin M. Yee '63 EE
(614) 895-7747 ext. 121 (B)

CHICAGO
Evita Vulgaris '79 PH
(708) 713-1394 (B)

DETROIT
Bradford Bates '59 EE
(313) 594-7957 (B)

HAWAII
Richard R. Lowe CP 61
(808) 923-7666 (B)

MINNESOTA
John R. Peterson '75 EE
(612) 933-8790 (B)

NEW MEXICO
Lola Matysiak '91 CE
(505) 662-4359 (H)
Penny Plummer Fusco '90 ME
(505) 672-0025 (H)

NORTHEAST OHIO (Cleveland)
Robert L. Wilcox CE 55
(216) 271-8740 (B)

PHOENIX
Stephen B. Russell '60 EE
(602) 991-4433 (H)

ST. LOUIS
John N. Drobak '69 EE
(314) 935-6487 (B)

SAN DIEGO
Peter J. Waldo '81 EE
(619) 536-3039 (B)

SOUTHERN CALIFORNIA
Arthur T. White '48 EE
(818) 884-1175 (B)

TUCSON
Russell S. Robinson '32 GE
(602) 296-6536 (H)

REGIONAL DIRECTOR

Bonnie Jones
(617) 253-8222
BJONES@MITVMC.MIT.EDU

BOSTON
L. Dennis Shapiro '55 EE
(617) 227-6886 (B)

CAPE COD
Harry Ferullo '40 ML
(508) 362-9016 (H)

CAPITAL DISTRICT OF NEW YORK
Joseph K. Ting ME 74
(518) 475-3082 (B)

HARTFORD
Jack V. Drake '54 ML
(203) 747-8604 (H)

LEHIGH VALLEY
Karl A. Seeler '75 ME
(215) 759-5956 (H)

MAINE
Nathan H. Acker '43 OE
(207) 839-3097 (H)

NEW HAMPSHIRE
Norman P. Soloway '62 MG
(603) 668-1400 (B)

NEW HAVEN
Marita Gargiulo Holl '77 LI
(203) 248-8047 (H)

RHODE ISLAND
S. Martin Billett '48 GE
(401) 245-8963 (B)

SOUTHEASTERN MASSACHUSETTS
John P. Dowd '59 PH
(508) 992-6518 (H)

WESTERN PENNSYLVANIA
Christopher V. Deephouse WC 78
(412) 263-5068 (B)

REGIONAL DIRECTOR

Janet Serman, Associate Director
(617) 253-8242
JSERMAN@MITVMC.MIT.EDU

ALASKA
Douglas Franklin '85 GY
(907) 564-5022 (B)

NORTHERN CALIFORNIA
Stephanie Littell '79 EE
(415) 474-9510 (H)

OREGON
Kathi Futornick '71 AR
(503) 235-5022 (B)

PUGET SOUND
Malcolm Best '71 AR
(206) 454-7284 (B)

SALT LAKE CITY
Terrence D. Chatwin '63 ME
(208) 526-6914 (B)

REGIONAL DIRECTOR

David Walker
500 5th Avenue, Suite 2500
New York, New York 10110
(212) 254-1122
(212) 354-3688 (FAX)
DWALKER@MITVMC.MIT.EDU

DELAWARE VALLEY
Russell G. Blount '80 CE
(215) 561-0460 (B)

FAIRFIELD COUNTY
Tanya E. Segel '84 CP
(212) 308-8525 x224 (B)

LONG ISLAND
Alan M. Sack '79 LI
(516) 822-3550 (B)

MIAMI
Robert D. Howard '69 MG
(305) 447-7500 (B)

MID-HUDSON VALLEY
Henry Schmitz '55 CE
(914) 463-3529 (B)

NEW YORK
Yee Wah Chin '74 MA
(212) 827-3616 (B)

NORTHERN NEW JERSEY
Michael A. Semeraro, Jr. CE 82
(201) 794-6900 (B)

PALM BEACH
Arnold J. Rothstein GM 51
(407) 848-4914 (B)

PRINCETON
Eric V. Wallar AA 89
(609) 467-5665 (B)

ROCHESTER
Robert M. Phipps II '79 MG
(716) 377-4002 (H)

SOUTHWEST FLORIDA
John Hrones '34 ME
(813) 349-2848

TAMPA BAY
David L. Lapides '71 CP
(813) 229-3321 (B)

WESTCHESTER
Jack Solomon '63 CM
(914) 789-3052 (B)

INTERNATIONAL REGIONAL DIRECTOR

Louis Alexander
(617) 253-8244

BELGIUM
Ferdinand Dierkens ME 48
(32) 2/345-29-47 (H)

FRANCE
Robert Varese
(33) 1/40-88-79-79 (B)

GERMANY
Martin Schloh CM 90
(49) 221/66-41-51 (H)

GREAT BRITAIN
Geoffrey H. A. Morton GM 81
(44) 71/344-7800 (B)

GREECE
Theodosios P. Boufounos OE 75
(30) 1/32-16-735 (B)

IRELAND
John J. H. Miller MA 65
(353) 1/679-7655 (B)

ITALY
Alvise Braga Illa
(39) 2/26-00-01-60 (B)

MEXICO
Gonzalo Maldonado CE 76
(52) 5/596-8757 (B)

PORTUGAL
Charles A. Buchanan, Jr. SL 73
(351) 1/396-02-97 (B)

SPAIN
Higinio Guillamon Duch GM 81
(34) 1/522-61-11 (B)

SWITZERLAND
Alan E. Hodgkinson '82 EE
(41) 41/81-12-44 (B)

TURKEY
Ahmet Coskun ML 67
(90) 1/257-62-38 (B)

SR REGIONAL DIRECTOR

Robert Blake HM
(617) 253-8243

AUSTRALIA
Robert H. Nordlinger '69 GM
(61) 3-243-7255 (FAX)

PEOPLE'S REPUBLIC OF CHINA
(Beijing)
Zhao Fangxiong '30 EE
(86) 1-256-2768 (FAX)
(Shanghai)
Xie Xide PH 51
(86) 21-5493232 (FAX)

HONG KONG
Frankie P.Law '86 OE
(852) 845-0091 (FAX)

INDONESIA
Rudy Setyopurnomo SL '92
(62) 21-386-8187 (FAX)

JAPAN
Hajime Mitarai '65 EE
(81) 44-549-5424 (FAX)

KOREA, REPUBLIC OF
Woong Kil Choo '66 ML
(82) 42-869-4210 (B)

PHILIPPINES
Gerardo A. Borromeo '82 GM
(63) 2-8164107 (FAX)

SINGAPORE
Lim Hock San CM 74
(65) 22-04551 (FAX)

TAIWAN, R.O.C.
Chi-Kuo Mao CE 83
(886) 2-381-1892 (FAX)

THAILAND
Sivavong Changkasiri '58 ME
(66) 2-246-4269 (FAX)

REGIONAL DIRECTOR

Bonnie Jones
(617) 253-8222

BRAZIL
Ricardo E. Degenszejn
(55-21) 253-0922 (B)

BUENOS AIRES
Domingo R. Giorsetti NU 77
(54) 1-784-2875 (B)

CANADA
(Ottawa)
Edward L. Cohen MA 71
(613) 564-3441 (B)

CHILE
Raul Laban EC 92
(56-2) 696-8093 (B)

COLOMBIA
(Cali)
Francisco J. Cruz Losada '59 ME
(57) 681-111 (H)
(Bogota)
Carlos Enrique Cavelier
(57)-1866-0350 (B)

GUATEMALA
J. Herbert Fischer-Saravia '49 ME
Fischer Y. Compania SA
Calzada Aguilar Batres 32-00
Guatemala City, Guatemala

INDIA
(Bombay)
Prakash G. Hebalkar EE 70
(91) 22-430-9528
(New Delhi)
Ravi K. Meattle '69 ME
(91) 11-63-1479

ISRAEL
(Haifa)
Joseph G. Zeitlen '39 CE
(972) 429-2324 (B)
(Tel Aviv)
Haim H. Alcalay '61 CH
(972) 329-3626 (B)

LEBANON
Nicolas Elie Chammas CE 87
P.O. Box 87656 Tunei Street
Beirut, Lebanon

PAKISTAN
Farrokh K. Captain '66 CH
(927) 764-1015 (B)

URUGUAY
Julio C. Franzini '52 EE
(598) 270-5894

VENEZUELA
Alfredo J. Peralta-Maninat '54 CE
(58-2) 762-65-67 (B)

REGIONAL DIRECTOR

David Walker
500 Fifth Avenue
Suite 2500
New York, New York 10110
(212) 354-1122

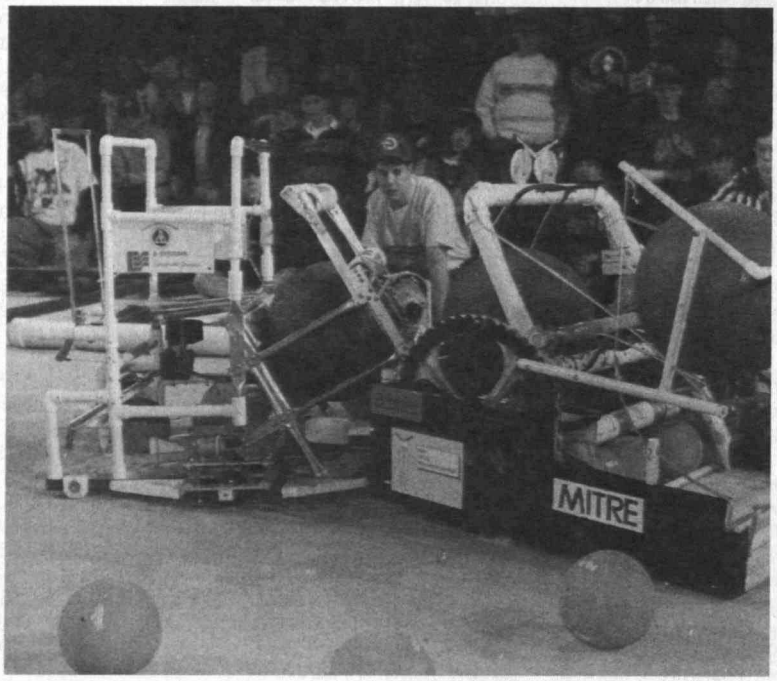
CANADA
(Toronto)
Gregory C. Coutts '77 ME
(416) 475-7535 (B)

PUERTO RICO
Tomas A. Gonzalez Laugier '80 ME
(809) 792-5600 (B)

By Michael-Jean Erard

2.70 Sprouts High School Branches

The finale of MIT's course 2.70, the legendary design competition for undergraduates, is now a hot pedagogical tool for high school students as well. The contest in which students battle each other with remote-controlled machines they designed and built from boxes of standard issue parts has spawned several progeny. The latest 2.70 offshoot is sponsored by a nonprofit educational foundation—US FIRST (For Inspiration and Recognition of Science and Technology)—and another operates under the banner of the High School Design Contest. Different as they are, the two ventures provide related and even mutually reinforcing educational adventures.



The "Dallas Road Runner," built by a team from E-Systems, Inc., and Dallas Christian School, grapples with the "Walrus," built by the University of New Hampshire, Winnacunnet (N.H.) High School, and Mitre Corp., for the last free kickball in the finals of the US FIRST "Rug Rage" competition.

US FIRST, founded by medical-technology entrepreneuer Dean Kamen, sponsors annual competitions that bring students together with professional engineers from corporations and universities. For the second consecutive year, teams of up to 60 students and half as many adults gathered in 25 sites across the country to design, build, and learn. The 1993 contest, dubbed "Rug Rage" because it took place in a carpeted "arena," pitted machines against each other to scoot around PVC pipe barriers and capture five- and fourteen-inch rubber kickballs. After six weeks of intense activity, "robo-gladiators" with names like "BEAST (Ball-eating Applied Science and Technology)" and "The Carpet Queen," along with their student drivers, engineering mentors, teachers, and cheering sections converged on a high-school gymnasium in Nashua, N.H., for the hype and flash of the national finals.

"The goal of US FIRST isn't education, it's inspiration," said Kamen. "Major corporations with world class engineers are competing [along] with the kids with the hopes of inspiring them." Kamen believes that a critical problem in U.S. education is that the students who most need to take advantage of school programs, scholarships, and extracurricular activities aren't doing so because they're too easily distracted by false heroes, such as athletes and rock stars.

Woodie Flowers, PhD '70, a US FIRST advisor and the professor of mechanical engineering at MIT who created 2.70, agrees. "Unless the United States improves its technical education system, I will probably retire in a Third World country," said Flowers, who also designed the "Rug Rage" playing field and served as competition emcee. "A technology-based education is the only way to turn things around."

Some of the engineers who work with high school students as US FIRST volunteers are veterans of Flowers' earlier project and of its international sequel, people like Cameron Miner, '92, a design engineer at Kamen's firm, DeKa. Miner participated in both 2.70—in which individual students build a machine in the midst of a regular MIT semester—and the International Design Congress (IDC)—in which machines are built in two weeks over the summer by teams of college students from MIT, England, Germany, and Japan. "2.70 is about deadlines and meeting a goal with limited resources," Miner explained. "IDC is about communication of ideas and cooperation. US FIRST is more directly letting kids see what is exciting about engineering by getting them involved with what engineers do. It's like trying to expand the area of contact between the engineering world and the rest of the world."

It seems to be working. Sean O'Rourke, a 17-year-old senior who is on the team linking New England Telephone Co. with Don Bosco Technical High School in Boston, spent a winter school holiday working on a machine with his teammates. "I told my friends, I don't care what they think about this contest," he said. "I'm having fun. Look at me here—they're probably at home sleeping."

"The engineers don't just tell us to get this, get that," said Greg Henebry, 17, member of the NYPRO, Inc. and Clinton (Mass.) High School "Gael Force" team that won in 1992. "Sure, we had ideas about engineers: you know, the pocket protector and all that," said teammate Chris Vattes, also 17. "But we got here and realized they're just regular people. And some of them are even pretty cool."

US FIRST does not stipulate that stu-

PHOTOS: ASSOCIATED PRESS

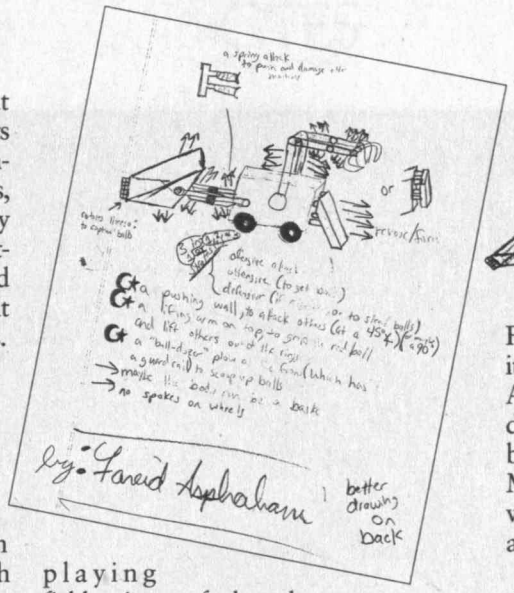
dents actually build the machines, but teams are encouraged to involve students from brainstorming, testing, and assembling to operating. For insurance reasons, students are not allowed to use company machine tools, but both Henebry and Vattes did work with a computer-aided design system and learned how to edit videotape footage of their team's progress.

"The true value of the students is in the ideas they bring," said Andrzej Skoskiewicz, SM '93, another DeKa design engineer and technical coordinator for the competition. "They haven't encountered all the boundaries yet; they're a resource." And when students have to distinguish which designs can be built with the given resources, Skoskiewicz said, they're introduced to the realities of engineering.

NYPRO engineer Wayne Paradis noticed an unanticipated side effect of the competition. "After the contest, we discovered a bond, a respect between the engineers," he said. "They've learned how to work as a team. We also love the contest because it's a chance for us to compete against big companies. We're a small company in a small town, and we get to do very well against companies that are household names."

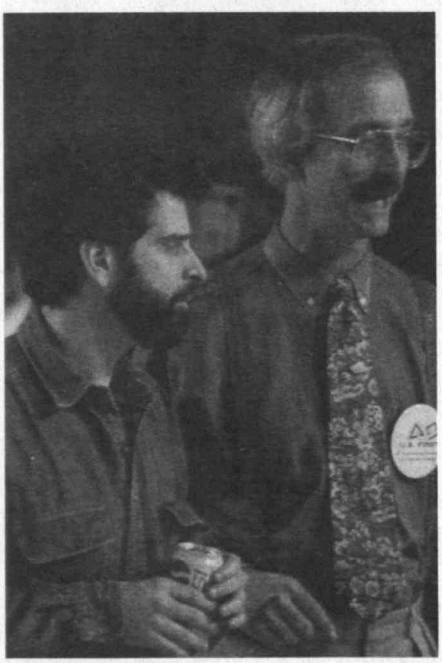
When companies finally tally their out-of-pocket and overhead expenses and the value of 15 to 20 hours of volunteer time on the part of a number of engineers, they estimate their contributions at $70,000 to $250,000. That investment admittedly bears more than educational fruit: while nurturing future engineers, the contest serves at once to showcase local engineering talent and demonstrate community involvement on the part of technology-based companies. But is the benefit to the corporation and the community worth the outlay?

"No doubt," said Paul Jensen, SM '79, NYPRO's director of training and development. The Clinton-based company's cash outlay was about $20,000, he said, which pays for the $5,000 entry fee (which covers only a portion of the cost of the competition), testing materials, the construction of mock playing fields, pizza to fuel work sessions, and transportation to the competition. More than a dozen NYPRO engineers worked intensely on the project. It's all worth it, said Jensen. "I think it's a 10-to-1 return for the money."



Drawings were one way for students to document their ideas, which flew thick and fast during the "Rug Rage" brainstorming phase.

But Finn Arnold, an engineer from Bose Corp. in Framingham, Mass., voices a caveat: "The success of US FIRST depends on how the media does its job at getting the message out," said Arnold, who worked on a team with students from Framingham High and Assabet Vocational/Technical High (both in Mass.) "Would this amount of effort be worth it for only 20 students and without any publicity? Probably not."



Collaborators in technology education: entrepreneur Dean Kamen (left), founder of US FIRST and its high-school design contest, and MIT Professor Woodie Flowers.

Extensive publicity was never in doubt, for Rug Rage was designed for television. In 1993, the competition was covered by Whitten Communications' Channel One, a broadcast service for high school audiences, ABC's 20/20, and a gamut of local media. Both Flowers and Kamen have been interviewed numerous times since. Someday, said Kamen, "we'll be on MTV."

US FIRST depends on companies willing to invest sizable resources and requires a full-time central staff. But what if students want to organize more informally? What if a school wants to offer this kind of experience, but doesn't have a corporate sponsor? Associate Professor Harry West, PhD '86, and a slew of MIT students and graduates have been working on the alternative model. In 1993, their High School Design Contest (HSDC) gathered more than 200 Boston-area students—from Cambridge Rindge & Latin, Boston Latin, Newton North, and Chelsea High Schools—in a series of local contests. HSDC also offers an outlet for students whose interest is stimulated by US FIRST's advertising, but who don't have access to the US FIRST infrastructure.

West succeeded Flowers in running course 2.70 and created its international version. And although his program for high school students is relatively new and local, West, like Kamen, thinks nationally: "This contest is designed to work at the grassroots level, to be low-

DRAWINGS: FAREID ASPHAHANI

cost. Whatever we do should be workable in every high school in the country," he said.

HSDC participants apply physics concepts to building machines that can push a soccer ball (and maybe an opposing vehicle) through a goal at the end of the competition table. In six weeks, teams of two or three students design and assemble their machines—maximum weight, four kilograms—entirely with hand tools. They work at home or in school industrial shops or multipurpose areas after class time, supervised by teacher volunteers. By the day of the intercity competition, students have competed close to home several times and have had time to modify or improve their machines.

Heidi Weatherford, who with teammate Jarrett Allen operated the winning machine, said that the competition was the most exciting thing that ever happened to her. Presumably she also was pretty excited at the award ceremony at the White House with President Clinton.

"HSDC competitions get the students involved more directly for less money and without input from a central organization or professional engineers," said DeKa's Skoskiewicz, who wrote a master's thesis under West on implementing low-cost design contests in high schools. "HSDC is not spectacular, but the aspects are far-reaching," Skoskiewicz said. "You can see the benefits more directly on the students." Before the contest, students would typically search for one correct solution to a proposed design problem. After the contest, they suggest several potential solutions, which to Skoskiewicz and West indicates a firmer grasp of physics and design concepts. "The teachers are educated and empowered as well," West points out. "It's their project, it hasn't been handed down to them by someone else."

West has operated the Boston-area program for three years, with the help of $1,000 grants for each participating school from the MIT Council on Primary and Secondary Education and NSF's Engineering Coalition of Schools for Excellence in Education and Leadership. All travel is local, thus low in cost, and overhead is absorbed by schools. Careful management of resources, such as the recycling of motors and other expensive kit items from previous HSDC and even 2.70 contests, helps to stretch the dollars. But in the long run, "the quality of the design education program depends on the amount of community support, not on the amount of available money," said Steve Fernandez, '89, a physics teacher at Boston Latin.

The success of the program also depends on the energy and initiative of the students—for which Bonny Tom, 15, is Exhibit A. Tom participated in HSDC '92 at Boston Latin, and when she moved to Newton North the following year, she wanted to continue. She assembled a group of like-minded students and the necessary tools and materials, and a true grassroots team was born. The team developed its machine without proper electrical hookups and controllers, practiced without a mock-up of the competition table, and showed up at MIT without ever having any competitive experience. Tom and her colleagues went on to defeat Chelsea in the second round. What's more, she inspired two teachers, a curriculum consultant, and three students from Newton North to participate in a summer competition at MIT to prepare themselves to develop a school-sponsored team for USDC '94.

A few students have participated in both the US FIRST and HSDC competitions. Margarida Fernandes, a junior at Boston Latin whose US FIRST team included student mentors from MIT, acknowledged that the higher-profile contest was fun. But, she added, "if we win here [in HSDC], it's better, because we didn't have someone telling us how to build our car. We built it all ourselves. And we've been working on this car for just forever."

"Each contest approaches a different group in a different manner," said Skoskiewicz. "Each has its merits. US FIRST is large-scale, large sponsorship, big image. It's more creating an image of a super-engineer. The HSDC is addressing real and immediate educational needs at the high school level. The results of US FIRST are hard to see. But with the high schools you can get down, get your hands dirty, see the benefits directly on the students." That sounds like a good one-two punch: if technology is going to compete with sports and entertainment for the attention of high school students, it'll have to be both big and glamorous as well as local and hands-on. □

MICHAEL-JEAN ERARD is a freelance writer and a graduate student at the University of Texas at Austin.

CLASS NOTES

19 75th Reunion

Brace yourselves for the following news. As I reported briefly in the last column, our class president, **Donald D. Way**, died in a local hospital on July 1. Among those I called to inform of Donald's passing was **George Michelson**, and a few days later I got a notice from a friend of George that George, too, had died. These two men were active for MIT and participated in some of its operations. Don was a fund solicitor, an Alumni Council member, an Educational Council secretary as well as president of his class.

George Michelson was a Fund Special Gift Solicitor and a member of our Class Reunion Committee. They both helped me in my class secretarial duties. We shall miss them in one way or another.

Douglas Burckett died of heart failure last July 27 at his home in Lincoln, Mass., where he had lived for the past 40 years. He received an SB and SM in electrical engineering and took time off from MIT to serve in the U.S. Army Corps of Engineers in France during World War I. After graduation, he worked for the U.S. Forest Service in Idaho and the Washington Water and Power Co. He also helped plan the electrification of the Cascade Tunnel, Great Northern Railway's passage through the Cascade Mountains. In 1929, Burckett came to Boston and began a 36-year career as an electrical engineer for the Boston and Maine Railroad. After mandatory retirement at age 65, he became an architectural construction foreman for Sasaki, Dawson, and DeMay. With the Appalachian Mountain Club, Burckett and his wife helped build Cardigan Lodge in New Hampshire. He served as club president in 1953 and was active in many club committees. He also served for three decades in Lincoln town government. At age 85, he made a 100-mile trek around Mont Blanc in France. "He was hale and hearty up to the last minute. He was cross-country skiing up until 1989. A year ago he was hiking mountains in New Hampshire," reports his daughter, Jenifer Burckett-Picker. Burckett leaves his wife, Phillippa, two daughters, and three granddaughters.

If I receive further information on these class members, I will report it. In the meantime, keep eating and breathing and doing always the best you can in this busy world.—**W.O. Langille**, secretary, Box 144, Gladstone, NJ 07934

20

Please send news for this column to: **Harold Bugbee**, secretary, 313 Country Club Heights, Woburn, MA 01801

21

"Architecture is frozen music" is a captivating epigram created many years ago by **Samuel E. Lunden**, retired California architect and one of about six '21ers from Course IV who have achieved prominence in their various firms along the West Coast. In our judgment, that quotable quote should be widely publicized—not only for its sheer beauty and wit, but also to encourage young people to consider entering a major professional field combining utility and artistry. In a recent phone conversation, Sam tells us that he and his wife, Leila, are enjoying senior years in their lovely home in Rancho Palos Verdes. To us, that's music too!

A phone call to Alex Hawes, wife of the late **Munroe C. Hawes**—chemical engineer turned real-estate magnate—discloses she has 14 grandchildren and 5 great-grands. Alex lives nearby in the family home in Sea Girt, N.J., on Boston Boulevard and Hawes Way, the latter so-named to honor the town's longtime assessor. . . . Likewise via phone, Helen St. Laurent, wife of the late **Raymond A. St. Laurent**, Course X-A, who served for years as our popular class president,

Franz Schneider
1887-1993

Versatile Grad Dies at 105

Franz Schneider, '09, who had a long career in public health, finance, and business journalism, died April 9, 1993, in Key Largo, Fla., as a result of complications from hip surgery. Before his death at the age of 105, he was believed to be MIT's second oldest alumnus. Schneider's son, Franz Jr., a Harvard graduate, reports that his father claimed in jest that he hadn't gone to college, only a trade school.

After being tutored in mathematics by poet Robert Frost when Frost was still a young teacher, Schneider went on to Phillips Academy in Andover and from there came to MIT for SB and SM degrees in the new science of bacteriology. He taught for a few years in the Institute's Biology Department before he embarked on a career in public health, first as a health officer for towns such as Wellesley and then at the Russell Sage Foundation in New York.

During World War I he served in the Army, leaving military service with the rank of major. After a year as head of the Research Department at American International Corp., in 1920 Schneider moved into the financial field as assistant to the president of First Securities Corp. In 1921 he became the financial editor of the *New York Evening Post*, in 1924 the financial editor of the *Philadelphia Public Ledger*, and in 1925 financial editor for the *New York Sun* and general manager of Munsey's Publications. He was also the American correspondent for the *Economist* of London and a columnist in the inaugural edition of *Fortune* magazine.

In 1930 Schneider became VP of Newmont Mining Corp., where he worked until retirement in 1953, with time out to serve as a WWII administrator in the War Shipping Administration and as a postwar consultant to the Department of State. He continued as a consultant for Newmont Mining until 1988. Schneider also served as a director of the Federal Reserve Bank of New York during the 1950s and as a trustee of Mutual Life Insurance Co. of New York for 24 years. He was a founding director of the Chemical Fund and the Eberstadt Fund.

For the last 20 years, Schneider had lived in Oyster Bay, Fla., spending winter months in Key Largo. An active yachtsman all his life, for 40 years he had enjoyed sailing his 52-foot yawl *Hutoka* with his family and many friends.□

says she still maintains their homes in Maine and Connecticut. She sounds wonderful despite complaints of sight and hearing.

Father Time continues to take toll of our classmates, numbering 43 who supplied addresses in the latest count. We extend heartfelt sympathy on behalf of the class to the families of four who have departed our ranks. . . . **Louis Mandel** died January 1, in Hollywood, Fla. A native of Newark, N.J., Lou graduated in mechanical engineering. He had retired as president of a Newark diversified packaging company.

Eugene S. Clark died on January 3. Born in Orange, Mass., he crammed many interests into a long life, beginning with a broad education and World War I Army service in France, followed by raising a family and continuous participation in civic, scientific, religious, and sporting affairs. Gene studied biology at MIT. Starting as water analyst in the Illinois Department of Public Health, he retired as chief of its Bureau of Special Services. He leaves his wife and three married daughters. A loyal supporter of MIT, we recall several pleasant phone calls to his San Diego retirement home about alumni activities.

John R. Hardin, major general, USA (retired), died at his home in Easton, Md., on January 9. The *1948 Alumni Register* says he was district engineer for the New Orleans district, Corps of Engineers, and the 1955 issue lists him as president of the Mississippi River Commission, headquartered in Vicksburg. His daughter, Mrs. Nancy Hardin Sumner, advised MIT of his loss and added, "He attributed all the things he was able to accomplish in his life to the training he received at MIT."

Harold N. Ewertz of Farmington, Conn., died there February 26, 1991. He was born in Elizabeth, N.J. At MIT, he studied ocean engineering in the naval architecture and marine engineering course. Specially interested in welding, he was a manufacturer's representative for several specialty firms. One-time chair of the Boston Chapter of the American Welding Society and member of its board of directors, he had developed expertise on welding electrodes to the point of addressing sections of society through the nation. Harold is survived by several children and grandchildren.

Now, will you please help us by sending your news, fresh off the pen, the typewriter, or computer, as you prefer. We also welcome postcards or phone calls.—**Carole A. (Cac) Clarke**, secretary, 608 Union Lane, Brielle, NJ 08730, (908) 528-8881; **Samuel E. Lunden**, assistant secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274, (213) 833-1480

22

Your class secretary must report to you the passing of two of our classmates. **Percival J. Higgs** of Ottawa, Ontario, Canada, died on April 26, 1992; and **Calvin I. Young** of Abilene, Texas, died on January 29. Sorry, no further information was supplied. Do send me news of yourself. Cordially—**Martha E. Munzer**, secretary, 4411 Tradewinds Ave. E., Lauderdale-By-The-Sea, FL 33308

23

I received letters from classmates who attended the reunion. The letters expressed thanks for the good time they had and gratitude for me "being there" as chairman.

William L. Searles died on December 25, 1992. He lived in Los Angeles, Calif. He prepared in liberal arts at the University of Bordeaux and studied architecture at MIT. He was with the Tennessee Eastman Co. for many years.

I need to hear from you all.—**Royal Sterling**, secretary, Apt. D201, 2350 Indian Creek Blvd. W., Vero Beach, FL 32966-5103

24 70th Reunion

I have heard from the MIT Alumni/ae Association that **Harold Clarke** passed away January 11, 1992. There are no known survivors. It is always sad to hear when another classmate passes on.

There has not been an avalanche of letters from the classmates of 1924, therefore I have little to report on class activities. Let me know what you are doing.—Co-secretaries: **Katty Hereford**, 237 Hacienda Carmel, Carmel, CA 93923; Col. **I Henry Stern**, 2840 S. Ocean, #514, Palm Beach, FL 33480

25

Sam Spiker and Grace and **Stanley Lane** represented 1925 at Technology Day last June.

A memorial service for **Karl Van Tassel** was held at the MIT chapel on July 10. Sam Spiker came down from New Hampshire to attend.

Arthur Odegard writes that he is 91 years old, in good health, and still in love with same wife of over 64 years. He has one son, one daughter, plus five grandchildren and three great-grandchildren. He summers in Melrose, Mass., and winters in Largo, Fla., and still gets to square dance occasionally. He says that after graduation he did something that had never been done before: "We were very friendly with Edward Porter St. John, a famous botanist in *Who's Who*. He had invented a new method of classifying ferns and asked me to make the drawings for him. Previous to his invention, ferns were classified by physical appearance, location, climate, and comparison with other ferns. He invented three liquids in which to soak the fern, and then he had it dried on blotting paper and finally pressed and sealed between two pieces of transparent glass. In this way, the fern became a transparent mass, its original outline was retained and its veins were like black threads varying in width. This method is now accepted the world over, and St. John said that I had the honor of making fern drawings that had never been done before. I'm not a botanist, but I sure learned a great deal from making those drawings."

It is with sadness that the passing of **Fred W. Greer** must be reported. He died on July 3, at Aynstey Place in Nashua, N.H. Fred was well known to many classmates. He was an active member of many reunion committees and served as class president from 1955 to 1965. He was an excellent golfer over the years until back problems required him to give up the game. Following graduation he joined the family-owned J.W. Greer Co. in Cambridge as an engineer and was chief engineer from 1930 to 1945. He became president of the company in 1945 and served as chairman of the board from 1955 to 1961. Fred invented, developed, and patented a wire belt. This led to the formation of Wire Belt Co. of America and Wire Belt Co., Ltd. of England with Fred as president. When Fred retired he left these successful companies in the hands of his son Wade, '52. Fred is survived by his wife, Eleanor (Fuller) Greer, a daughter, Nancy, his son, and a number of grandchildren and great-grandchildren.

The list of deceased in the July issue of the *Review* noted that **Louis Long, Jr.** died in Boston on November 22, 1992.—**F. Leroy "Doc" Foster**, secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

26

Please send news for this column to: **Donald S. Cunningham**, secretary, Eventide, 215 Adams St., Quincy, MA 02169, (617) 328-1840

27

Please send news for this column to the secretaries.—**Joseph C. Burley**, secretary, 1 Harbourside Dr., Delray Beach, FL 33483; **Lawrence B. Grew**, assistant secretary, 21 Yowago Ave., Branford, CT 06405

28

It is possible that the euphoria of our 65th Reunion has left us bereft of news for this issue, as there is little at hand to report. A blessing from this situation, however, is that there are no deaths of classmates to convey. Though there are many who have limiting health problems, we still have a stake in the future.

George Palo, our class agent, has returned from an enjoyable post-reunion three-week visit to England and has heard, in his accumulated mail, from two classmates. **Sidney Brown**, who has been a regular participant in our reunion, was unable to attend this time and would like to hear from others. (Address: 2784 S. Ocean Blvd., #103e, Palm Beach, FL 33480.) George also heard from **Leon Locklin**.

Recent publicity of Professor Vannevar Bush prompts me to reminisce about our campus days. Remember the room in Building 10 with doors open, fans blowing, racks of glowing tubes generating heat, and mysterious rumors of a weird machine performing mechanical/mental gymnastics, sometimes with the correct answer? While prowling the corridors at the reunion trying to avoid getting lost beyond return, I found the room door, with the sign "Vanneavar Bush Lounge," opened to a restful setting for weary scientists.

A check on Florence Jope Smith finds her recovery slow in spite of her determination and interests. A delight to Florence is hearing from friends and associates. Her address is still Florence Smith, Cogswell SE, Rm. 271, Carleton-Willard Village, 100 Old Billerica Rd., Bedford, MA 01730.

An antidote to the traumas of today are remembrances of simpler times, i.e., our campus days.—**Ernest H. Knight**, secretary and president, Box 98, Raymond, ME 04071

29 65th Reunion

A note comes from **Murry Brimberg** and his wife, Mary, from Silver Spring, Md.: "Our travels for this year have been somewhat curtailed due to sudden gall bladder attack a few months ago. Regretfully, the surgeon had to

resort to the long method of laparoscopy, which usually has less after effect and hospital stay. The recovery has been straightforward. We will soon resume our normal activities. We join you next year for our 65th Class Reunion. Our grandson just graduated from the University of Pennsylvania. Our other grandchildren are variously involved; the oldest will receive a PhD in physics next year, the other two are in medical schools."

I received a note from Class Agent **Bill Bowie**, who lost his wife recently, from Olmstedville, N.Y.: "I have just completed a brief visit to West Newbury, Sally's old hometown. There were several items that she wanted taken back and it gave me an opportunity to visit some old friends. Of course it would be one of the hottest periods of the summer, which did not add to the comfort, but I did see a number of people I wanted to see and visit."

Due to the lack of class news because of eye problems, I am taking the liberty of inserting an unpublished letter of **Dick Bolton**'s from some time back.

"This has been a horrible winter with yesterday being the worst snow storm in 10 or more years, followed by wind and cold. I am too old for this sort of thing and lack of exercise has caused my arthritic back and ankles to cause trouble. Oh well, you can't win 'em all! . . . I am getting ready for spring by discarding old clothes even shoes that no longer fit because of swollen ankles. Also had my M47 striped trousers let out for my granddaughter's wedding in June. Easter week will see me on my way to Toronto to see about a suitable present, etc. . . . There is an MIT meeting at Concordia University this evening but with the bad weather and streets blocked, I am too old to venture out and take a chance on being knocked down on slippery unplowed streets. Income tax time is here again. I don't owe them any money but they insist I give them an explanation to account for my singular good fortune."

I regret to announce the death of the following members: **Wayne F. Koppes**, on January 29, 1992; and **Helen Walther**, on October 4, 1991.—**Karnig S. Dinjian**, secretary, P.O. Box 83, Arlington, MA 02174, (617) 643-8364

30

Supplementing the item in the April '93 Notes about **Tom Wigglesworth**'s retirement activities, it appears that Tom has now embarked on a new project, namely, developing a computer exhibit for Cleveland's new Science, Engineering, and Environment Museum, due to be completed in 1996. The exhibit will be entitled "A trip thru a chip" and will "hopefully show how computers work." Tom is also active in the community service unit of the Cleveland Rotary. . . . **Jack Bennett** reports that he and Bunny had a pleasant luncheon get-together in Naples with Peg and **Bill Jackson**. Bill still keeps his hand in at his Pittsburgh Des Moines Steel Co. operation. The Bennetts enjoyed their "third honeymoon" in March '92 on a South Pacific cruise ending in his "old five-year stamping ground with Goodyear—Australia. Didn't recognize Sydney, it has changed so much." They are planning a "fourth honeymoon" on an Alaska cruise this summer. . . . As previously reported, **Al Bird** and his wife, Grace, retired some years ago to Rockport, Maine, where he has been active in community affairs. In the 1970s he served two terms as a selectman and more recently chaired a committee that monitored the design, construction, and regulation of a new sewer system for the town of Rockport. He is an ardent sailor and says he has both a Japanese 31' Damio class auxiliary sloop and a Herreshoff $12^1/_2$ classic sloop. . . . Eleanor and **Frank Nettleton** moved to Essex Meadows, a life-care facility in Essex, Conn., several years ago. He feels it was fortunate that they made this move when they did since Eleanor has been in the Health Center for more than a year. Frank says there are five other MIT grads at Essex Meadows. His own activities include playing pool, gin, and occasionally walking a few holes of golf.

Ruth and **Jim Biggane**, who attended the 60th reunion, still live in Rancho Mirage, Calif., near Palm Springs. His present activities include reading, studying the stock market, and "bringing up" his grandchildren. His note included the following bit of personal philosophy: "As we grow older, our appreciation of MIT grows. We miss our old friends and the fun and pain we had together in our undergraduate days. It is good to note the changes in curriculum—how much more effective and timely." Jim has suggested that I include in obituary paragraphs the address of the classmate's spouse, if she or he is living, so that classmates may write a note of sympathy if they wish to do so. I plan to adopt this suggestion. . . . We have at hand a notice that **Fred Holt** died in Boca Raton, Fla., on December 11, 1992. Fred worked for many years for Brownbridge Mills in Troy, Ohio, and retired as executive vice-president and technical director in 1974, shortly after Brownbridge was taken over by Kimberly-Clark. During his years in Troy, Fred was active in community affairs: He was a an eight-year member of the Troy City Council, chair of the building fund for the Troy Library, and a member of the governing board of the Hobart Sports Arena, as well as a 50-year member of TAPPI. His wife, Joyce, was active in hospital auxiliary work and at one time was Ohio state chair of hospital auxiliaries. At the time Fred retired, he and Joyce owned some beach-front property on the island of Grenada on which they planned to build a retirement home. However, possibly due to political unrest in Grenada, they settled for a home in Boca Raton. The notice about Fred was of special interest to me, because he and I were members of a triumvirate that produced a thesis at MIT in the spring of 1930. The third member was **Bob McCarron**, who died in 1979. In addition to Joyce, whose address is Apt. 313, 501 S.W.Place, Boca Raton, FL 33432, Fred is survived by a daughter, April Heslar, who has an MS in clinical psychology and does rehabilitation counseling of retarded, emotionally disturbed, and drug-addicted patients.—**Gordon K. Lister**, secretary, 294-B Heritage Village, Southbury, CT 06488

31

Have had a particularly hard time trying to dream up something to write about this month. We are all getting so old that there are not too many of us left, so I was quite taken by the weekly note in the *Portsmouth* (N.H.) *Herald* by **Raymond Brighton**. He was writing about a new water-tower construction contemplated by the city, and referred to my 1931 thesis, "A Study of the Public Works Department of the City of Portsmouth." My interest in the works of the city probably came from my Grandfather Pender, who in addition to other offices was mayor in 1902, and my father, who had been called upon to help straighten out some financial problems in 1909 and served on the council off and on until he died in 1925.

After Grandma Pender died in 1917, my grandfather came for Sunday dinner and would then visit his sister (Mrs. Sherburn) at the Plains and various friends around town. I would go with him, acting like an animated question box. The pumping station for the city's water was located across the B&M tracks north of the Sherburns' farm. The pumping station was a small brick building with what were then to me a fascinating pair of duplex pumps that pumped the water from the sand and gravel reservoir, which underlaid the area north to Newington. From my grandfather's experience in work (he started at age 10 as a bobbin boy in the Portsmouth Cotton Mill); in business as an insurance agent; as organizer of the Portsmouth Building & Loan Association in 1891; and in numerous political positions including school board, city council, sheriff, state representative and senator, as well as mayor, I accumulated a tremendous amount of information about local city affairs.

This knowledge was augmented by my father, who was treasurer of the Portsmouth Savings Bank and was also into local politics (city council in 1905, when he procured the insertion of provisions relating to the financial management of the city into its operating charter, including the addition of a city auditor, items that were regarded by some as too strict but that kept the city out of financial troubles as long as he lived).

In 1952 the Federal government took over the property that formed the backbone of the city's water supply, but I wrote into the takeover agreement that the Air Force would take care of its own water requirements on the base and that the government would replace the capability taken with other sources, which it did with the Bellamy Dam and Treatment Plant.

Years ago the Public Works Department heard of my thesis and requested a copy.—**Wyman P. Boynton**, secretary, 668 Middle St., Portsmouth, NH 03801

32

After being secretary of the class for 17 or 18 years, the nightmare that I feared seemed inevitable: I might miss an issue! The Alumni/ae Association sent me nothing—not even an obituary. Only a few letters from our classmates, including one from **Tom Weston**. It was a good letter with a lot of news about classmates. But I lost it and today is the due date for publication.

Well, I'll tell a bit about myself. I'm still fully engaged at Lloyd Laboratories, Inc. Besides normal business problems I find that I am busy preparing for OSHA inspections, preparing MSDS information, removing underground tanks, etc.

I am active with my hobbies—golf, tennis, bridge, chess, family, MIT, and others. On Father's Day I was given an audiotape of David McCullough's *Truman*. It is great and I highly recommend it to all.

William Pearce writes that Marjorie is recovering from her accident falling down stairs in New Bedford, Mass., July 1990. The Pearces do not travel anymore, not even to their residence in Florida. William hopes that next year will be better.

John Brown sends me information that Professor **H.H. Uhlig** died at the age of 86. He

received a PhD at MIT in 1932 and is listed as a member of our class. He was a renowned research chemist for many prestigious corporations. He left his mark in many fields but it is his work in "corrosion" that he is best known. He is survived by his wife, Greta, two children, and several grandchildren.

As for our mini-reunion in Arizona in April 1994, it will be interesting to see how many of our classmates in the Midwest and Far West are attracted. Because of our advanced age, I cannot be too optimistic.

WRITE! WRITE! WRITE!—**Melvin Castleman**, secretary, 163 Beach Bluff, Swampscott, MA 01907

33

Random thoughts on a momentous and rewarding 60th Reunion. In all, 38 class members were registered who were accompanied by 37 guests. Beginning with the usual Registration at McCormick on Wednesday, June 2, each of us was given a cardinal (not a St. Louis) baseball cap emblazoned in sky-high block letters (MIT 1933), which then became a readily distinctive .D wherever we went.

Benjamin Liberfarb models the Class of '33 "sky high" reunion hat.

Charalee and husband **Dick Fossett** were the smiling presenters (more on the Fossetts later). An evening dinner at McCormick featured a very talented brass quintet but they were outdone by a vociferous audience singing old standards and particularly the MIT songs we knew back when. I was *taken back to the TECH on Boylston Street* when it came to singing that most infectious of all MIT songs (as you architects know who spent their five years there before 1938).

Thursday, June 3, began with a bus tour labeled "Boston-made in Cambridge by MIT." (To be honest, those Boston buildings were designed by some guys who came out of the Rogers Bldg. *in Boston.*) The luncheon following was in the very new **Herbert E. Grier** (our very own Herb) Room in the EG&G building, which featured a talk by Professor Paul Penfield, head of the Department of Electrical Engineering and Computer Sciences. After the evening dinner at McCormick, we took off by bus for Symphony Hall and Tech Night at the Boston Pops. What distinguished MIT there was our presence and our singing of a song composed by John Wilbur, '26 (but with words by Alvin Kahn, '85). "Arise All Ye of MIT" sounded more like the drinking song from *Traviata*, so not knowing it, that's the way I sang it.

Friday, June 4, was Technology Day marked by Memorial Services at the MIT Chapel and a program "Riding the Wave of Innovation; the Ocean and MIT" held in the Kresge Auditorium. (See *TR,* October, p. MIT 11.) Although gill-full by then we sat down to luncheon where Class gifts to MIT were announced, which this year totalled $35 million. The Class of 1933 was proud to give $3.335 million however we were bested by the 65th Reunion Class of '28 which gave $16 million so very modestly. MIT President Charles Vest touched on the reliance on various sources of revenue, especially the alumni/ae, to bridge the gap between the price of an MIT education and what students pay. The future waits on all institutions of learning and the students they teach, he said, with MIT playing a leading role. Next on the agenda, the 60th reunion photo was taken counting 54 obviously pleased faces, 33 of whom were card-carrying male registrants and the remainder the most desirable. Later, transported to the Sheraton Tara Hotel/Resort at Danvers, Mass., we ate dinner to light impromptu piano music and make-do entertainment.

Saturday, June 5, following a very hearty breakfast at the Sheraton, a large group took off by bus for the environs of Peabody and Salem. The history of the witch-hunts there in an earlier Puritanical time contrasted with the serene calm of our day there. Lunch at the Salem's Peabody Museum there was followed by two different groups guided each on separate floors of the large museum. I chose to view a rare showing of internationally known seascapes lent to the museum by Queen Elizabeth from the days when Britannia ruled the waves. After returning to Danvers and the Sheraton we sat down to the traditional lobster dinner. More than sufficiently filled to the brim and increasingly jovial, most of us got up and spoke on matters germane or not to the Class and the 60th Reunion to almost delirious applause. **Cy Hapgood** was far and away the most entertaining raconteur relating the answers to questions put to one applicant seeking to win a basketball scholarship to a basketball college. Cy had us on the floor with the applicant's answers to the simplest questions. The delighted gathering ended with the prouncement of the new class officers by Steve Rhodes, the Nominating Committee's chair. The following graciously accepted their new responsibilities: **Wilber B. (Bill) Huston,** president; **Richard L. (Dick) Fossett,** vice president, West; **Leonard J. (Len) Julian,** vice-president, East; **Berj Tashjian,** secretary; **Edward E. (Ed) Simpson,** assistant secretary; **Charles P. (Charlie) Britton,** treasurer; **Stephen H. (Steve) Rhodes,** assistant treasurer; **Herbert E. (Herb) Grier,** class agent; and **Cyrus S. (Cy) Hapgood,** estate secretary.

Sunday, June 6, after buffet breakfast and goodbyes, each of us left Danvers to go back to Cambridge and wherever. The 60th Reunion was history.

Just received (July 9) very warm greetings from Charalee and Dick Fossett who by their account are doing everything and more that one does in the Swiss Alps, accompanied by their son and his wife and also by their daughter and her husband. I'll list a few jaw-breaking names of places they visited: Jungfraujoch, Trummelbach (eight waterfalls hidden in a mountain), Aarschlucht and Gornograth (lesser mountains possibly). My question is how did they get up all that energy after the hectic 60th Reunion where they both seemed to be everywhere whenever. Let's hear from the rest of you! I need Class News.

Unfortunately, I must conclude in a sadder vein to report the deaths of fellow classmates. **Charles E. Cullison** died January 19, following a brief illness. Charles was employed by the Beacon Oil Co., then served in the U.S. Army in World War II followed by employment with Container Corp. of America, retiring in 1974. He is survived by wife, Doris, and two daughters, and two grandchildren. Cullison graduated with an SB in chemistry. . . . **Calvin H. Mohr** died May 8, as reported by a niece of his wife, Regina, who passed away in 1992. Calvin had a particularly active career and life. He received an SB in chemical engineering. Calvin's employment includes Du Pont, Celanese, Ringwood Chemical, Patterson Foundry, Velsicol, and with Sperry where my biographical material tells me he was assistant to the president through 1958. There are no other known survivors. . . . **J. Stuart Patterson** died May 21, after a short illness. J. Stuart was also a chemical engineering graduate with an SM degree. He was with American Cyanamid for 38 years, retiring in 1976. His survivors include a son, a daughter, a brother, and five grandchildren. . . . **Robert A. Dobson** also died May 21. He graduated Course 9B, general engineering and science, and is last known to have retired from the Dobson Brothers Construction Co., Lincoln, Neb. . . . **Joseph W. Horridge** died January 3, 1988, graduating from Course 2, mechanical engineering last address known as Scottsdale, Ariz. He had advanced to brigadier general, U.S. Army, from which service he had retired.—**Berj Tashjian,** secretary, 1245 Briarwood Ln., Northbrook, IL 60062

34 60th Reunion

In taking over **Bob Franklin**'s mantle it is necessary for me to report the loss of several of our class members, two of whose deaths should have been reported previously. **Earl A. French** was living in Fort Worth, Texas, when he passed away on September 27, 1988. The other is **Herbert Plass** who was living in Minnetonka, Minn., when he passed away June 1, 1986. Also reported by the Alumni/ae Office is the death of **Albert E. Heins,** which occurred June 24, 1992, while living in Ann Arbor, Mich. Also reported is the death of a **Burton Williams** of Chesterton, Ind., who died October 16, 1992. He is not in our yearbook.

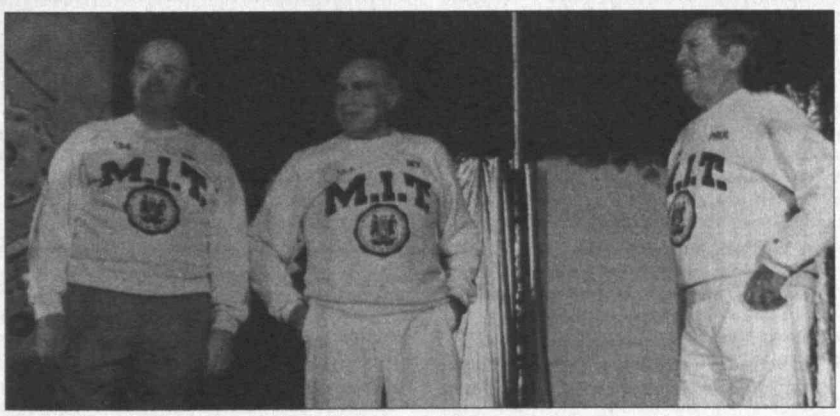
The *Worcester Telegram & Gazette* carried a good obituary article on **Thomas A. LaCava** who was 84. He leaves a wife Beatrice, a son and four daughters, ten grandchildren, and two great-grandchildren. He was chief engineer and deputy director of the State Water Supply and Pollution Control Commission for many years before his retirement. During World War II he was a civilian working for the Corps of Engineers. He was charter member of the Society for the Protection of New Hampshire Forests.

A letter from **Ed Sieminski**'s son informed us of his death on May 5 in Fullerton, Calif. He and his wife, Felicia, were born in New Bedford. When he graduated from Tech in electrical engineering he worked successively for Sylvania Electric, American Machine and Foundry, and finally for Grumman Corp. in New York until his retirement. Both he and his wife are very accomplished ice skaters taking part in competitions in the Northeast. Ed was a well-known figure as a skating judge. He is survived by his wife, his son, and four grandchildren.

PHOTO: L. BARRY HETHERINGTON

It is with great personal regret that I must report the death of **Arthur J. Manson** on July 15. He had been in declining health and his heart just stopped. Arthur and I were in the same fraternity and after graduation and marriages a strong friendship continued. With our wives we made several trips together. One was to Spain for several weeks in 1983. Another trip included John Best, '35, and his wife to the Copper Canyon in Mexico. The Bulls and the Mansons on one occasion were able to take in the Fiesta of the Mexico City Chapter of MIT Alumni. Arthur's business career was successful in varied enterprises in the Houston-Austin area of Texas. In his later years he established a very successful plastic products business that his sons are now carrying on.

On a more cheerful note I turn to a long letter that **Irving Kusinitz** sent to me to replace one that Bob Franklin was not able to use due to his illness. I quote, "The latest trip taken by **Paul Lappe, Hal Bellinson,** and me was to celebrate the 80th birthday of Hal and Irving and the 78th of Paul. The time was spent in April 1992 at Club Med on Saint Lucia in the Windward Islands. It included Paul's two sons: Mark Lappe, a professor at the University of Illinois (and their five children) and Donald Lappe, a cardiologist from Salt Lake City (plus his wife and three children). Hal invited his daughter Jill Bellinson, a clinical psychologist, her husband and two children. With Paul's wife, Helen, Hal's wife, Tema, and Irving's wife, Marion, there was a perfect reunion with 22 in all. At Club Med there were watersports, gorgeous scenery, and fine entertainment at night as well as good food. We exhibited particular pride in our MIT affiliation by wearing special garments designed by the Lappe family. They were T-shirts with enlarged photos from freshman days and on front and on back the letters 'MIT' and the great seal." Irving sent a picture of the three men about to sing "I wish that I were back again." The three were an outstanding feature of amateur night. During their stay at Club Med they were often stopped and asked about MIT and their affiliation with it.—**George G. Bull,** secretary, 8100 Connecticut Ave., Chevy Chase, MD 20815



The MIT chapter of Club Med (1934 branch) entertains the troops in the Windward Islands: from left, Hal Bellinson, Irv Kusinitz, and Paul Lappe.

35

John B. Ballard and **Lester A. Brooks** just completed a two-day MIT '35 mini-reunion on July 9, at Bend, Ore., according to a postcard received from Jack and Les. Much of the time was spent on two of Bend's golf courses. They wrote, "Anytime any '35 class member appears in Georgia or Oregon with his golf clubs, we'll organize another outing."

I can now report that **Stanley M. Lane** and his wife, Charlotte, are happy and in good health and still live in Helena, Mont., in spite of the information that was included in the July class notes. Furthermore, they will be coming down to Oceanside, Calif., in February for a month of warm weather and golf. . . . **Jim Eng** is pushing to have a crew on the Charles at our 60th, which is only 22 months away. Right now, I think the only way any of us will be able to get into the shell is with the help of a crane. We have 22 months to get our squat muscles built up.

The three children of **H. William Parker** and Marjorie wrote a Parker mid-summer newsletter reporting that their mother died of cancer on June 17 and that as of July 15 Bill had been moved to the Littleton Nursing Home in Littleton, Mass., to be near his daughter, Ellen Swenson, in Acton, Mass. Another daughter, Susan Bastura, lives in Middletown, Conn., and his son, Tom Parker, lives in Eden Prairie, Minn.

Walter H. "Stocky" Stockmayer reports that he will be attending a meeting in San Diego next March. He says he has too much gardening, which is keeping him from climbing only one mountain this year. I guess all that snow has finally disappeared. . . . Speaking of mountains, I visited the Mt. St. Helen's Park when I was in Seattle in June. The park presents a fantastic view of what the enormous amount of energy did when the mountain exploded, causing the largest landslide ever and reducing the mountain height from 9,610 feet to 8,300 feet. Forests of flattened trees extend for miles.... I will be attending the Mowatt Family Reunion in Sandwich, N.H., on September 25.

I would be delighted to hear from you, especially those of the remaining 257 members of the class who have yet to surface. Even a postcard would be most appreciated. The easiest thing would be to telephone me at (619) 432-6446, and if I am not there, leave a message up to three minutes long. I promise a reply.—**Allan Q. Mowatt,** secretary, 715 N. Broadway, #257, Escondido, CA 92025

36

Continuing the odyssey on or near I-95 from Philadelphia to Virginia: At his home in North Wilmington, **Art Carota** told of his 1936-7 job: $18 per week for working construction daytime *and* preparing the payrolls at night. After World War II army service with **Larry Kanters** and **Gordon Thomas** at the vulnerable Panama Canal (October '88 Notes), Art went to work in his brother-in-law's construction business, who later left it to his two children and Art. Now into the third generation of both families, they have built housing developments and office, industrial, and shopping centers. Ownership of many buildings is retained by working family members via a holding company. To quote Art: "If you're going to earn much money, you have to take the risks and run your own business." Outside activities have included membership in Lloyd's of London and director of American companies, but he is taking it easier after a heart operation in July.

Next day at lunch **Leonard Chandler** recalled playing bridge with fellow commuter **Charlie Holman** at the 5:15 Club room in Walker Memorial. Later while working for a PhD, Len got his first paychecks—$50 per month for 10 months as a teaching fellow. Then he had a long and interesting career with DuPont: starting up the first nylon plant, eliminating bugs at the second, and working on offshoot polymer processes. There followed years of patent liaison as assistant technical director, on licensing and sales to ICI, Bayer, etc., and concern with a sometimes outcome of great success in a large U.S. business—attempts to break it up. In retirement, Len keeps active in grape culture and the chemistry of oenology.

Stan Lukoff was Course XVII but took a course in metallurgy and got a job with U.S. Steel, which had just begun hiring college men. A honeymoon in Hawaii and a civilian job working for a military contractor (but also checking his work for Uncle Sam) put him on Oahu December 7, 1941. Then four years with Foster Wheeler in Houston, building plants under wartime rules. They could use only 10 percent new equipment, and so scrounged and made do for the rest. Stan spent his last 15 active years in research and design of agricultural products for DuPont.

Bernard Sturgis came to the Institute with a BS from De Paul University, roomed for two years with **Howard Turner** while getting their PhDs, and, with Len "Gus" Chandler, **Robert B. Woodward,** Professor Avery Ashdowne, '14, and others formed the Ice-Pickers Club. They met Mondays to make ice cream with a laboratory chipper, play blackjack, and adjourn to Jacob Wirth's Restaurant. Bob Woodward (deceased 1979), listed in the 1936 *Technique* as '37, was a chemical genius who skipped ahead to graduate with us and got a PhD a year or so later. He won the Nobel Prize in chemistry in 1965 for synthesizing such drugs as quinine, cortisone, and tetracycline, thus creating and extending structures envisioned by 1947 laureate Sir Robert Robinson (see **Charles Saffer** last issue). Bernie Sturgis possibly saved Woodward's life in a 1935 chem lab. An experiment with potassium cyanide under slight pressure used ordinary soda bottles (quite safe). But when Bob released the cap, some of the contents squirted over his face and into his open mouth. Bernie shouted "don't swallow!" and got a water hose to flush it out. His career with DuPont overlapped those of Len Chandler and Howard Turner. He worked in patents at the end, with much travel to Russia and Japan. He was a guest at Howard's 50th wedding celebration.

Bill "Nick" Nichols (Course II), at home in Lutherville, Md., has been a boatman from

childhood—sailboats beginning age 10, oarsman on freshman crew, a 43-year career designing ships for all yards of Bethlehem Shipbuilding, and the owner of a Pierson 37, which he has sailed to Florida several times. He was chairman of the ship machinery committee of the Society of Naval Architects, and for Bethlehem Ship designed power plants for hundreds of all kinds and sizes up to 285,000 deadweight tons. A few years before retiring as chief engineer, the trial run of a container ship was caught in a wild storm off Hatteras. With all but one of the 100-plus engine crew members in their cups, the blowers on both engines went faulty. Bill and the one able crewman each nursed an engine to move the ship at eight knots back into port.

Cheers and a salute to the lives of **William F. Lewis** and **Marshall S. Carter** (lieutenant general retired). Bill Lewis, grad student in chemical engineering after degrees at Notre Dame and Illinois Tech, died December 27, 1992. He had been an executive of Lewis Tar Products and Fox & Lewis Contractors in Illinois, and executive director of the Rockford Housing Authority. His 50th reunion biography records 47 years of successful marriage and four great children. Wife, Louise, continues at 2165 Calle Buena Ventura, Oceanside, CA 92056. On the telephone in July, she said she had just returned from visiting children in Illinois; a daughter was coming in August from her work at the Vatican, and Louise was planning to return with her to see Rome. . . . Marsh Carter died February 18. He had a great and unusual career as an Army officer after graduating from West Point in 1931 and an SM in Course I at the Institute. He served at points around the world, with numerous decorations by the U.S. and several foreign governments, culminating in three stars as deputy director of the CIA and director of the National Security Agency. General George Marshall chose him as his special assistant in China 1946-1947, again when General Marshall was Secretary of State until 1949 and Secretary of Defense until 1951. In retirement from 1969, Marsh was president of the George C. Marshall Foundation. I commend his 50th biography to you for its humor: in 1939 he wrote an army manual on stereoscopic range and height finders—"in great demand until some joker invented radar and thus ended a promising technical career"—and the last paragraph is even better. Wife Préot Carter's address is c/o Mary Carter Nickerson, 1271 N. Tenderfoot Trail, Parker, CO, 80134.—**Frank Phillips**, secretary, 1105 Calle Catalina, Santa Fe, NM, 87501, (505) 988-2745; **James F. Patterson**, assistant secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4171

37

Received a note from **Leon "Bud" Strauss**, who is now retired from real-estate investing. He has many interests—activities, hobbies, family, travel, etc. "p.s. even computers!" His address is 140 Greenfield Ave., San Rafael, CA 94901.

From *The Meadville* (Pa.) *Tribune* editorial page: "We're pleased Meadville Area Recreation Authority has seen fit to give a formal name to the ice rink at its recreation complex on Thurston Road. As of September 24, the rink will be known as the **George S. DeArment** Ice Arena. The new name will forever honor one of the most dedicated advocates of the recreation complex. DeArment, retired president and co-chair of Channellock, Inc., a charter member of the authority, has given more than 20 years to the betterment of recreational services for those of all ages in the Meadville area. His leadership in the development, operation, and growth of the recreation complex has been significant. The same can be said of his unwavering support of the unique facility, personally and financially, over the past two decades. Authority members could not have chosen a more appropriate and deserving person to honor." Right on, George!

Dave Tuttle writes from Stanford, Calif., that he travels east every few months to see relatives in New England and to go back to Amherst College (he graduated there before going to MIT). Visits MIT once or twice a year. He swims every day and is also "into computers." . . . **W. Cameron Mitchell** is president of Southern States, Inc., a director of two banks, and lives in Hampston, Ga. He is interested in scouting, the United Way, and the Georgia Foundation for Independent Colleges. He visited with Marge and **Dick Young** in Fall 1992 in Boston. He likes to travel, watches sports, and says his health continues to be good.

Charles Kahn reports: "Involved with Hilton Head (S.C.) Squadron of the U.S. Power Squadrons—sail and power boating and extensive educational courses in boating, piloting, navigation, weather, etc. Looking forward to helping out in the sailing activities of the 1996 Olympics to be held in Savannah. My wife, Catherine, has had a stroke but is completely recovered physically and only has a 'comprehension' problem in verbal situations. I've had a node and half of my thyroid removed starting in January '93 and since radiation in May I've been well recovered and feeling fine. Best regards to all."

And from **James M. Ewell**. "Board member (past chair) of Cincinnati Children's Hospital. Currently head of the Board Oversight Committee overseeing $115 million building expansion. Doubling research facilities—and of course, multi-deck parking. Board member (past chair) The Cincinnati Symphony Orchestra. Continue to head board oversight of operation and maintenance of the orchestra's summer home 'Riverbend', on the bank of the Ohio River. Am also a board member of the Indian Hill Historical Society. In between board meetings, Bette and I get in some travel—North Cape of Norway our last big trip. Best regards!"—**Robert H. Thorson**, secretary, 66 Swan Rd., Winchester, MA 01890; **Leonard Seder**, assistant secretary, 1010 Waltham St., #342B, Lexington, MA 02173

38

Class President **Frederick Kolb** has started early to find a reunion chair for our 60th. He began by reviewing all the previous committees from the 20th on. He drew a blank on the 20th and 30th. The data that he has on the 35th is a puzzle: He has **Paul Black** as chairman with **G. Edwin Hadley** and **Horace Homer** as committee. I remember being at Stratton Mountain but have no recollection of being on the committee. Fred would appreciate any information on these reunions. Send it to **Frederick J. Kolb, Jr.**, 211 Oakridge, Rochester, NY 14617-2511; (716) 342-3093. He is also looking for an assistant class secretary. Any volunteers?

While we are looking for volunteers, we badly need an archivist to put our memorabilia of past class activities in some kind of order. Anyone looking at the class file at the MIT Museum will find only one picture. Nothing else. I collected a great deal of data for the 50th Year Book, but it needs sorting and, in some cases, identifying some of the people in the pictures.

August T. Rossano, emeritus professor of civil engineering at the University of Washington, Seattle, received the 1993 Lyman A. Ripperton Award of the Air & Water Management Association. This award is given to an individual for distinguished achievement as an educator in a field related to the mission and objectives of the Association. "Russ" has had a most interesting and varied career. He has traveled all over the world as a consultant to governments on waste management. In addition to his consulting work, he has been very influential in the academic field. He developed one of the largest interdisciplinary approaches to the study of pollution in the United States. He brought together faculty and students from many fields to study the problems of pollution. He has had the satisfaction of seeing his former students in important positions in schools, universities, government facilities, industry, and consulting firms.

A letter just received from **John F. Glacken** explains why he and Fran didn't make the 55th. He had two cancerous sections of his intestines removed in late November. They traveled up from Florida by easy stages this spring and are now home in East Falmouth, Mass. He is doing very well.—**Horace H. Homer**, secretary, 702 Quaker Rd., North Falmouth, MA 02556, (508) 564-4374

39 55th Reunion

Fred Grant, chair of our 55th Reunion Committee, scheduled a meeting for September 23 at MIT. Fred says the shoe-box safe in which '39ers' questionnaires were stored has been opened. Contents are about to be sorted and edited. An exciting summary will be in your mailboxes well before these notes appear.

Aaron White has impressive recording and playback hi-fi equipment and he invites classmates to tell him the names of bands that played during 1935–1939 for 1939 class dances. Personal comments and anecdotes about the dances are welcomed. Please write Aaron White, 77 Varick Rd., Waban, MA 02168-1827.

For the fourth consecutive year, MIT was named the top engineering school in the country by *US News & World Report* in its annual ranking of America's best graduate schools. The magazine's March 22 issue has MIT at the top of the list of 193 accredited engineering schools offering master of science and doctoral degrees. In other graduate programs surveyed, MIT was first in chemistry, tied for first in computer science and mathematics, tied for second in physics and biology, second in geology, and sixth in management.

Dave Morgan started in Poland, studied two years at the University of Liege, Belgium, and then enrolled at MIT, where he was promptly baffled by missing intermediate steps in Professor Norbert Wiener's blackboard demonstrations of calculus techniques he presented within split-seconds of the time freshmen were required to do the day's problems in physics. This led Dave to form a mutual assistance consortium that included **Irv Peskoe** and **Howard Schachman**. Irv went on to be elected to three terms as mayor of Homestead, Fla. Howard achieved international recognition for his work as professor in molecular biology at the University of California at Berkeley.

Dave's career operations included owning a high-tech machine works that produces parts for aerospace majors and drilling for and producing oil, mostly in the USA. Dave now divides his time between New York, West Palm Beach, and international travels.

MacKenzie Keith was awarded a PhD in Course XII in 1939. Now, as emeritus professor of geosciences at Pennsylvania State University, MacKenzie has written a new book, *Geodynamics and Mantle Flow. An Alternative Earth Model*, published by Elsevier (Amsterdam) in hard cover and also in *Earth Science Reviews*, V. 33 (1993): 153–337. The essence of the book is a critical review of the evidence regarding the nature of the "Earth Engine," the drive mechanism for mountain building, volcanism, igneous intrusion, earthquakes, and continental drift. It encompasses geophysical, geochemical, and petrologic data, as well as structural evidence and the broad aspects of Earth history.

Fred Schaller and Anne stimulated the Wellesley Board of Selectmen for Town Meetings to add two members. The Schallers may be on the verge of acquiring a Pearson Tritan, a 28-foot cabin sailboat ideally suited for relaxed summer sailing in and out of New England's bays and harbors. . . . **Morrie Nicholson** attended a Theta Delta Chi mini-reunion in Naples, Fla., during April. Also there were Stella and Arthur Gilbert ('35), Natalie and Sam Brown ('35), Louise and Austin Cross ('35), James Eder ('34), Alice and Winthrop Johns ('37), and Lester Moffett ('35). While on a Gulf cruise vessel, they met Dick Ewert ('37). Morrie is updating the professional engineers' examination for metallurgical engineers. Also, Morrie seeks information items about the last years of classmate **Stu Paige**, who died shortly after World War II. Please phone items to Morrie at (612) 645-1613.

Eke Smith and Nancy are well and active in Haworth, N.J. Nancy is in good voice, expert in tennis, and the Smiths are looking forward to the 55th Reunion songfests. . . . **Bob Sackheim**, after making undergraduate dean's lists six times (out of eight), served in World War II on the Manhattan Project at Los Alamos. After that, Bob and Betsy started a mail-order business, sold later to Longines. Now in retirement in Larchmont, N.Y., Bob divides time between golf, piano, and creating puzzles as well as solving them for Alan Gottlieb's Puzzle Corner in the *Technology Review*.

Bob Withington and Betsy report cancellation by parties unknown of their planned autumn trip on the Volga River in Russia. Bob works about 150 hours each month assembling his high-wing two-seater airplane kit with its 80-hp engine. Maiden flight is scheduled for early 1994. . . . Brigadier General **Dick Cella** retired from the U.S. Air Force after World War II and has operated his famous restaurant in New York ever since. He and Georgina face possible new problems if taxes are increased on restaurants.

Bill Wingard and Anita are pleased that their fine sons assumed management of the Wingard machine works. The sons are finding huge anomalies in costs, and subsidies are enabling foreign competitors to undercut USA-based businesses. Hence, the Wingard sons, like their parents, have formidable challenges. . . . **Wade Caywood** formed Caywood Electronics, Inc., sold it, and retired in 1987. Until recently, Wade was active in the Rotary Club, YMCA, Boy Scouts, Little League, and amateur radio in Reading, Mass. He and Mary enjoyed their summer home on Frye Island in Maine. A week before this writing, Mary died. Now would be a good time for friends to write Wade at 220 Woburn St., Reading, MA 01867.

We are saddened by news of the deaths of two classmates. . . . **Joseph R. Perkins, Jr.**, Course VIII, died January 24, 1992 in Newark, Del. We have no details. . . . **C. Eric Olsen**, president of Newport Ropes, Inc., died May 7 in Marion, Mass. There were no details.

Ernie Kaswell, class agent, reported for 1992 that about 349 '39ers were active. I have no information about estate planning any classmate has completed. However, because Congress has reported "out of committee" major reductions in the allowable limits on exemptions for bequests, it appears this topic needs thorough and ongoing reconsideration. Hilda and I have updated our estate plan. We completed the pre-need data summaries and have calculated, on test basis, the IRS 706 forms. Thus, we have generated reassurances that our bequests have been optimized and will flow, in due course, where we intend. As a service to classmates who may have similar situations, we suggest that after Congress finishes increasing the nation's taxes, '39ers should recalculate the impacts and determine what, if any, optimizing changes might be worthwhile.—**Hal Seykota**, secretary, 2853 Claremont Dr., Tacoma, WA 98407

40

A note from Colonel **George R. Weinbrenner**, USAF-Ret., says, "Enjoying retirement with my wife, Billie, here at the Army Residence Community in sunny San Antonio. Active in Air Force Association at local and national levels." . . . **Jay Zeamer** sent a note to **John Danforth** in response to Jack's message of congratulations to Jay on his being honored on the 50th anniversary of his heroic flight to map the Pacific islands. Jay wrote, "Thank you for your note. Yes, that Wednesday was quite a day. Two of our classmates, **Boyden 'Bud' Hale** and **Edmond DiGiannantonio**, were here to share things with me. Bud got me into flying in the first place in the MIT Flying Club. Yes, we still have our men's breakfast each Tuesday at 8 o'clock at Andrew's Harborside in Boothbay Harbor, Maine. You're welcome to join us if you're ever in town at that time."

Class Treasurer **Richard Babish** sent me a note saying that he had just received word of the death of **Lawrence E. Welch** of Ponce, Puerto Rico, on July 13, 1991. . . . **James I. Thomas-Stahle** of Richardson, Texas, died April 22 and **Robert W. Chase** of Oklahoma City passed away on January 22. There is no further information on any of these classmates. . . . In addition, **Delano Wight** died in Green Valley, Ariz., on January 4. He was a member of Santa Rita Kiwannis Club, Computer Club of Green Valley, and Eastrose Unitarian Fellowship, Portland, Oreg. He was also active in the Arizona Sonora Desert Museum of Tucson and in the Wisconsin Shakespeare Festival at the University of Wisconsin.

Class President **Norman Klivans** sent me a letter to class officers primarily in regard to the 55th Reunion in 1995. He starts by writing, "Hope this note finds all of you well and enjoying the summer. Alice and I are in good health. We are looking forward to a family reunion over August 1 to celebrate Norm's 75 years of hard work and good living. No doubt all of you have or will be going through the

same experience." Norm goes on to discuss plans for the reunion. Eliza Dame of the Alumni/ae Association suggested that there *not* be parallel activities in Cambridge on the Tuesday and Wednesday when most of the attendees will be at Woodstock. Instead, "post-reunion" programs can be arranged in Cambridge in Friday night, Saturday, and perhaps even on Sunday for those who would like to stay over the weekend. For those who do not drive, bus transportation will be provided to and from Woodstock. Other suggestions were floated for opinions from the class officers. As plans develop, we will keep you informed.

Please continue to send your notes, or make those telephone calls to me.—**Richard E. Gladstone**, secretary, 250 Hammond Pond Parkway, 1205 S., Chestnut Hill, MA 02167, (617) 969-5161

41

Slim pickins this month! MIT forwarded only one item, a newspaper report, missed by their clipping service in April.Classmate **Dave Saxon** was elected by his high school's alumni association to their hall of fame. He was inducted at a ceremony at the Cheltingham High School Little Theatre on April 16, 1993. Dave, a member of their Class of 1937, was recognized as a graduate of MIT, 14th president of the University of California, author of several physics textbooks and articles, and a life member of MIT's Corporation. His important affiliation with our class was not mentioned! At a post-ceremony reception, the inductees joined previous inductees, including professional baseball great Reggie Jackson, and Nobel Prize winner Michael Brown.

In the spring issue of the Caltech alumni journal, *Engineering and Science,* **Bob Sinsheimer** reviews what he refers to as "a curious, disturbing, and ultimately scandalous book," *The Molecular Vision of Life*, by Lily E. Kay. Her book presents a history of Caltech's Division of Biology from the mid-1920s to the late 1950s, when many advances in molecular biology were made at Caltech. Bob considers the history part of her effort as a work of "considerable scholarship and interest," but objects to her analysis that the Rockefeller Foundation sponsored this research as part of a Machiavellian plot to control human behavior on a global scale. He presents a good defense of the many famous scientists who were his friends and associates and appeared to be Kay's apparent targets. As a professor of biophysics in the division since 1958, and its chair from 1968 to 1977 before becoming chancellor of the University of California at Santa Cruz, Bob was in the catbird seat at Caltech during this era, and should know. As a nationally recognized expert he spoke forcefully on the ethics of genetic research and testified in Congress for more restrictive guidelines for recombinant DNA research.

Good news from the boathouse front. The **Charles S. Butt, Jr. '41** Crew Shell Fund reached $18,500, sufficient for initial purchase of the shell. Coach Stu Schmill, '86, plans to order it this September for delivery and dedication next spring. The fund will be kept open to provide funds to sustain the boat, thereby assuring that there will always be a Charles S. Butt, Jr. '41 shell in the MIT boathouse.—**Charles H. King, Jr.**, secretary, 7509 Sebago Rd., Bethesda, MD 20817, (301) 229-4459

42

Never too late for well-deserved kudos to a classmate. The May 20th issue of the Peterborough, N.H. *Transcript* had an article about **Bob (Hawk) Shaw** who was honorary marshal for the New Ipswich Memorial Day parade. He got national attention in 1962 as part of a surgical team that reattached a youngster's arm at Massachusetts General Hospital.

I was in town (i.e., New York City) recently and saw Ellie and **Harvey Kram** at dinner. Harvey is looking for support of NAFTA. All of you interested can get in touch with him at: 271-16G Grand Central Parkway, Floral Park, NY 11005.

Class news from all of you is at an all-time low! Let's hear what's doing. Every single classmate can't be in the doldrums at the same time!—**Ken Rosett**, secretary, 2222 Americus Boulevard, North, Clearwater, FL 34623

43

I must sadly report the death of **Henry Steinhauer, Jr.** (Course VI), on May 2 in Oak Ridge, Tenn. Following graduation, Henry served with the U.S. Navy in World War II, then spent several years with General Electric and Magnavox. In 1953 he joined Goodyear Atomic Corp. as an instrumentation development supervisor. He retired after 30 years of work in the engineering development of gas diffusion plants for uranium enrichment. Henry was a Life Fellow in the Instrument Society of America, serving as a local section president and a national division officer. He was active in the Lutheran Church, the Toastmasters, and the Boy Scouts. He is survived by his wife, Ethel, and numerous children, grandchildren, and family members. We mourn with them his loss and his unrealized hope to attend the 50th Reunion.

Reunion—Chapter 2

Monday, May 31, saw the first official reunion arrivals at Black Point Inn. After running a gamut of old reunion pictures, the guests were greeted at the registration desk by **Hans Walz** and **Mort Spears**, who distributed the necessary paperwork and the bundle of gifts. These included MIT hooded windbreakers and MIT tote bags. With cloudy skies and a rising wind, the jackets were very welcome. Idle conversation during lunch around the pool revealed that **Gil Edelman** would enjoy lobster at every meal if it were offered, and **Bob Mitchell** still commutes to his office via the Long Island Railroad.

Reunion attendees continued to pour in, requiring overflow accommodations at the neighboring Inn by the Sea. Political jokes were exchanged, **Bill Franklin** busily recruited golf players, and another group signed up for a cruise on a sailboat that formerly belonged to IBM's Tom Watson, Jr. Dinner was excellent, and the obligatory postprandial speeches by **Jim McDonough** and **Stan Proctor** were not excessive.

On Tuesday there were showers. Some fanatical tennis players, who had complained earlier about wind-blown dust, tried to ignore the raindrops. Other classmates drove through the weather to take in the attractions of Portland and Freeport. Stan Proctor continued the relentless pursuit of his Class Gift quarry unto the uttermost ends of the earth—the men's room at L.L. Bean.

Later in the day, the sun came out to brighten the cocktail hour, a time for further gleaning of items for Class Notes. **Bruce Horst** and

Chuck Lawson were members of the same country club for years without realizing they were MIT classmates. . . . **Bill Maxwell** lives with a bachelor son and does much of the cooking. . . . **Chuck Swett** and consort plan to attend a Quaker convocation in Oklahoma. . . . **Sherman Sackheim** intends to compose his own obituary and file it with the class secretary for future reference. After a sumptuous lobster dinner, we were entertained by a Down East comedian reminiscent of Titus Moody from Fred Allen's Alley.

Wednesday dawned bright and beautiful, ideal weather for the golfers and tennis players. Some folks followed the hiking trails around Prouts Neck. . . . **Curtis Smith** did some bird watching and located an occupied robin's nest under an umbrella at one of the poolside tables. . . . The McDonoughs and the Rorschachs took in the noted art museum in Portland, then lunched at a waterfront cafe, where we impressed a young waitress with our 50-year seniority. An afternoon rest prepared everyone for the cocktail party, formal dinner, and dancing. . . . President McDonough announced that all the class officers had been reelected to another five-year term. **Jim Spitz**, however, weary from the class agent responsibilities associated with the Class Gift solicitation, asked not to be reappointed. The president is now reviewing the short list to select Jim's successor.

To be concluded.—**Bob Rorschach**, secretary, 2544 S. Norfolk, Tulsa, OK 74114

44 50th Reunion

From the *Wall Street Journal* we learn that **Martin Annis** is now CFO as well as chairman of American Science and Engineering, Inc., here in Cambridge. . . . **Bill Sadler** writes that Williamsburg, Va., has been a pleasant retirement place for him and Rowena for the past four years. He and Rowena plan to attend the 50th Reunion along with Mercedes and **John Lednicky**. Bill's grandson, Brent, is expected to graduate with honors from the Naval Academy around that time. This may give Bill some scheduling problems.

A profile of **George Burdick** in one of our local papers tells us that after graduation from the Institute, George obtained a degree in psychology from Boston University and then worked as a senior engineer for the Baldwin-Lima-Hamilton Locomotive Co. in Philadelphia. From 1976 to 1981, he was the operator of the Mt. Washington Cog Railway in New Hampshire. The journey starts at 2,700 feet and ends at 6,288 feet, a 75-minute trek that on a flat road would last about three minutes. For seven years George served as curator of the Seashore Trolley Museum in Kennebunkport, Maine. He lives in Hudson, Mass., with his wife, Lindsey. They have three children and one grandchild.

We have some further information on **Bernard J. Duffy, Jr.**, whose passing we noted in our last column. He was VP and manager of crystallization technology at C.F. Nofsinger Co. for 19 years. Earlier, he worked for Standard Oil Co. in Chicago and was VP for technical centers for the J.F. Pritchard Co. He was active in his community and was a Navy veteran of World War II. His survivors include his wife of 40 years, Martha; a son, a daughter, and five grandchildren. We extend the sympathy of the class to his family.—Co-secretaries: **Andrew F. Corry**, P.O. Box 310, W. Hyannisport, MA 02672; **Louis R. Demarkles**, 77 Circuit Ave., Hyannis, MA 02601

45

Please send news for this column to: **Clinton H. Springer**, secretary, P.O. Box 288, New Castle, NH 03854

46

Please send news for this column to: **Jim Ray**, secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

47

Hank Rowan is back in the news this month—Piedmont College, Demorest, Ga., presented him with an honorary doctorate in business administration for "his major contribution to modern industry and his extraordinary demonstration of philanthropy—a $100 million gift to Glassboro State College in New Jersey." Betty Rowan was also honored with an honorary degree of doctor of human letters for "her active support of the Girl Scouts of America and her philanthropy and service to education."

John Keefe died in February of last year in Naples, Fla. He is survived by his wife, Catherine. We have no other information.

News has been *very* sparse the last few months—how about some letters?—**R.E. "Bob" McBride**, secretary, 1511 E. Northcrest Dr., Highlands Ranch, CO 80126

48

Gene Ashley represented MIT at the inauguration of the new president of Norwich University, Northfield, Vt. Norwich is the nation's oldest private military academy. . . . **Phil Lally** is with Teledyne-Mec in Palo Alto, Calif.; they make vacuum tubes for microwave power modules. Recently Phil was given the Robert Woods Award for Excellence in Vacuum Electronics Technology. The award was presented at the Vacuum Electronics Annual Review. Phil wrote that he and his wife, Mary Ann, enjoyed the 45th Reunion and are looking forward to the 50th.

Mike Oglo is pursuing patents for the Navy's Undersea Warfare Laboratory in Newport, R.I. The pressure of the job and some family requirements have resulted in his wife, Marilyn, remaining at their Florida home. Mike takes a long weekend in Florida every three weeks. One patent application relates to the larger capacity of microprocessors that allows designers to employ symbolic algebraic manipulations to achieve combinations of numerically intensive open-form algorithms. Previously, this required that each step have long operating periods on a mainframe. Mike's earlier experience in symbolic logic is very useful in his current job. The patents are to protect inventors in the lab which employs 140 PhD's plus others.

Denman McNear, our new class president, had a meeting with **Graham Sterling, George Clifford, Milton Slade, Marty Billett**, and staff members of the Alumni Association. We discussed class activities, the 50th Reunion, and raising funds for MIT. Denman appointed **Bill Maley** to be our class agent. As reported last month he appointed **Sonny Monosson**, Graham Sterling, and George Clifford to chair the 50th Reunion Committee.

Jack Page is a director of IMCO Recycling, a company that recycles aluminum cans. He and Imogene enjoyed an extended sailing voyage on the Aegean Sea. . . . **Barry Bloom** retired from Pfizer where he had been executive vice-president for R&D and a director of the company. Pfizer's chair and CEO said, "It's been my pleasure to have worked closely with Barry over two decades. I have seen firsthand how Barry elevated the status of Pfizer research and clearly focused its efforts so that today it stands as the envy of the industry." Barry joined Pfizer in 1952 and became president of central research and a director of the corporation in 1971.

Ralph Pickett spent 30 years with IBM before taking early retirement in 1987. He and his wife are involved in the San Jose Museum of Art. He is on the board of San Jose Institute of Contemporary Art. They visit Boston annually and go to Europe on art-related ventures. When Ralph was doing his research for a PhD at Yale, the lab apparatus blew up and involved the AEC and New Haven police. He switched to a computational thesis, which led to his IBM job. . . . **Stan Fingerhood** is a senior VP at Laidlaw Holdings. He continues analyzing investments and managing assets. He and his wife, Nina, have sons who are 34 and 15 years old. . . . **Don Atwood** was elected to the board of directors of Stewart and Stevenson Services, Inc. in Houston, Tex.

Ben Danziger died suddenly and unexpectedly. Melvin Gardner, '50, wrote, "Those of us who came to know and therefore to love Ben will miss him sorely." He never married but had nieces and nephews to whom he was devoted. . . . **Rose Armstrong** died in Racine, Wisc. . . . **George Webb** died in Buffalo, N.Y. During World War II he was a navigator on B-17s and was a prisoner of war for 10 months. At Bell Aerospace Textron he managed quality on the Agena rocket project.

Glen Macon died of lung cancer. In 1986 he retired from the Navy after 44 years of service. He had extensive service at sea and was commanding officer of the USS *Domato*. He spent 18 years with the Navy's Undersea Test and Evaluation Center. After retiring, he was mayor of Atlantis, Fla. . . . **Harry Beattie** died in Fairport, N.Y. . . . **William Engelmann** died in Plymouth, N.Y. His college days were interrupted by service as a co-pilot on B-29s over Japan. After graduation he worked for Long Island Lighting for more than 30 years. . . . **Ronald Gillis** died in Downey, Calif. . . . **Charles Fogg** died in Wakefield, N.H. He was employed in water resources, conservation, and environmental areas.

On behalf of our classmates I extend our sympathy to the families of our classmates.—**Marty Billett**, secretary, 16 Greenwood Ave., Barrington, RI 02806, (401) 245-8963

49 45th Reunion

Tom Toohy (class president) has been notified that seven more outstanding students for the academic year 1992–1993 have benefited from the Class of 1949 Student Financial Aid Fund. In the likely event that these students will one day rise to prominence, I am including some brief information provided in Tom's letter:

John Devlin received a chemical engineering degree and now works for the Aspen Corp., a Boston-area chemical engineering consulting and programming firm. John hopes eventually to provide developing countries assistance with their engineering issues. . . . Anna Jen

will be continuing chemical engineering studies this fall as a graduate student at Rice University in Houston and hopes to earn a PhD and become a professor. . . . Electrical engineering and computer science graduate Bilal Khan hopes to commence graduate studies next fall and will apply next year for a position as a staff researcher with MIT's Laboratory for Computer Science.

Intern positions with the National Institute of Health at Massachusetts Eye and Ear paid off for Yvette Morgan. As a permanent staff member, she is continuing her research on auditory nerve pathways in mammals. She is a graduate of MIT's course in brain and cognitive sciences. . . . Marion Casserberg will continue her UROP (Undergraduate Research Opportunities Program) project in chemical engineering (her major) as a senior this fall. . . . Chemistry major and senior Jacquin Niles is torn between medical research and clinical practice for his career.

The seventh recipient, senior Wendy Russell, wrote a letter, dated July 25, to Tom Toohy: "I was recently selected as a recipient of MIT's Class of 1949 Scholarship for the 1992-1993 academic year and am writing to thank you. I know that without this award and generous people like yourselves, I would not be able to attend MIT. I'm a senior anticipating graduation in June 1994 with a major in materials science and engineering and a minor in economics. I'm working at MIT for the summer, doing research in a UROP under Professor Peggy Cebe. in the fall, I will be doing my thesis with her. I'm currently working in the Polymer Physics Department studying the electric properties of some polymer blends. Specifically I am studying the dielectric constants of polymers to be used in enclosing cable underground. If we can find a polymer with a low dielectric constant that doesn't corrode in water and dirt, a patent could come out of it. I am really thankful for the experience I've had here at MIT.

"Once again, thank you for your most generous contribution to my education."

(Secretary's note: I am sure I speak for the class in saying that we take pride in supporting these outstanding young people.)

A note of unknown origin tells us that **Austin Marx** is enjoying retirement and doing volunteer work for several nonprofits. One of them is the World Business Academy, a networking organization of forward-thinking business executives whose mission is to help in the positive, sustainable transformation of the planet, including environmental and humanistic business practices. Another is the Institute of Noetic Sciences (Noetic—of, relating to, originating in, or apprehended by the intellect), with interests in exceptional human capabilities including healing and wellness. Yet another is the Center for Citizen Initiatives, which helps Russian entrepreneurs get small businesses started there and supports citizen environmental, agricultural, and sobriety programs. Austin is also on the board of the Santa Clara Valley Club of American Youth Hostels, which helps restore historic buildings for inexpensive travel and promotes international understanding. He still finds time for travel to the local northern California mountains, where he has a small cabin, and travel to Chicago to visit friends and relatives. He hopes to attend the 45th Reunion in Cambridge and Bermuda next year.

The management and staff of the Class of 1948 invited members of the Class of 1949 to attend a banquet with them in the Empress Room of the Hyatt Regency Hotel in Cambridge this past June. Among classmates and their wives who enjoyed the occasion were **Raffaele Belluardo, Jim Christopher, Bob Cowan, Fletcher Eaton, Don Gillespie, Harry Lambe, Ray Larson, Micky Ligor, Don Ridgley,** and **Tom Toohy.**

A letter from Richard Rorschach ('50) tells of the death, on June 23, of his brother **Harold Rorschach** in Philadelphia where Harold and his wife, Virginia, were visiting their daughter, son-in-law, and two granddaughters. Cause of death was a massive stroke. Harold was 66. A news release from Rice University in Houston paid tribute to Harold's distinguished career, characterized by a dual commitment to teaching and research. Through the years, more than 5,000 science and engineering students enrolled in his introductory physics courses. He also guided the research of many PhD graduate students. His research and publications in experimental low temperature physics and biophysics, the latter in collaboration with Baylor Medical School scientists, are recognized internationally. Harold received SB, SM, and PhD degrees in physics at the Institute, completing his studies in 1952. He was a member of Sigma Alpha Epsilon fraternity. Harold served as a deacon and an elder of the Central Presbyterian Church, and chaired numerous church committees, most recently the capital fund campaign and centennial committees. He was active as a teacher of adult church school and held a brown belt in tae kwon do.

Harold is survived by his wife, Virginia, daughters Kimberly Hart of Swarthmore, Pa., and Kelly Rorschach of Dallas; two grandchildren, and two brothers.

A card from Myrle S. Andrew tells us that **Robert T. Andrew** of Manassas, Va., died suddenly on May 8. . . . Also, a note from the Alumni/ae Association informs us that **Sigurd Hallager, Jr.,** of Lincoln, N.H., died February 19. . . . **Stephen J. Kovacs** of Dallastown, Pa., died May 26. I deeply regret the absence of further information on these three men.—**Fletcher Eaton,** secretary, 42 Perry Dr., Needham, MA 02192, (617) 449-1614

50

Robert "Bob" Snedeker writes that a mini-reunion of sorts was held in Falmouth, Mass., on June 24. The occasion was the summer meeting of the MIT Club of Cape Cod, where MIT President charles Vest was the featured speaker. Class members attending were Collie and **Nate Cook,** Susan and **Mal Green, John Malloy,** Barbara and **Ed Mason** (ScD '50), nancy and **Frank Parisi, Sam Raymond,** Pat and **Bob Snedeker,** and **Bill Timson** (Val Tereshkevith in our student years). Nat introduced President Vest. John was one of a group of three elected to three-year terms as directors of the club. Sam suggested that Nantucket be the site of our upcoming 45th Reunion in 1995. It is certainly time to begin planning for this reunion. If you are interested in working on the committee for the 45th, please contact our president, **Bob Mann,** or your correspondent. Thanks, Bob, for all the news.

David Mackes writes that he retired from Westinghouse several years ago. His main retirement project was to restore a 1965 MGB. However, all his wife's favorite projects are taking preference as of now. He is so busy that he wonders how he ever had time to go to work. . . . **Floyd Wideman** recently sought a position on the Palm Beach, Florida's Architectural Commission. After retiring twice, voluntarily the second time, **Claude Tapley** consults concerning the copper used in fusion reactors, the Superconducting Super Collider, and steel mill melt shops. He and his wife have become full time Floridians after five years of "snowbirding." His younger son just received a PhD in marine zoology from the University of Maine at Orono. . . . **Fred Barker** received the Meritorious Service Award of the Department of the Interior. Fred, a geologist, was honored for his outstanding contributions as a world-renowned expert on the formation of igneous rocks and their importance to understanding the origin of the continental crust. He has worked for the Department of the Interior for almost 40 years and has authored and produced over 100 scientific publications. He and his wife, Margaret, and three children live in Golden, Colo.

We are sad to report the following deceased members of the class: **Eugene French** of Leonia, N.J., in May 1993; **Harris "Bobby" Stone** of Alexandria, Va., in June 1993, and **Robert Boyden** of Gillette, N.J., in July 1993. In 1980 Bobby retired from the Office of the Chief of Naval Operations as director of research, development tests, and evaluation for long range planning. In 1979 and 1980, he was national commander of the Jewish War Veterans and from 1980 to 1985 he served as the organization's executive director.

Let's all start thinking about attending the 45th Reunion in 1995. It's not that far away.—**John T. McKenna,** secretary, P.O. Box 146, Cummaquid, MA 02637

51

The Priestley Medal, this nation's highest award in chemistry, will be presented by the American Chemical Society to **Howard E. Simmons, Jr.** at their annual meeting this coming April. The citation states: "Throughout his professional career, Simmons has consistently been in the forefront of chemical research and has had immense impact on scientists in his own generation and those who followed." Under his leadership, the Central Research Laboratory at DuPont made important advances in areas including chloroflorocarbon replacements, electronic materials, high temperature super conducting materials, polymer technology, biotechnology, and super computer applications. Named after Dr. Simmons is the "Simmons-Smith reaction," an organic reaction showing the conversion of simple olefins (class of compounds also known as alkenes) to cyclopropanes. Dr. Simmons is on the National Science Board of the National Science Foundation. He has received the Chandler Medal from Columbia University in 1991 and the National Medal of Science in 1992. He has been an adjunct professor of chemistry at the University of Delaware since 1970.

Enjoying retirement is not terribly different from working days is the message received from **James A. Barnes.** He is taking refresher courses in computer science, and writing game programs that analyze the human player and take advantage of the human's frailties. He is maintaining his physical being by walking, snorkeling, and dancing.

About to complete a five-year term as the founding chief of the Beta Theta Pi District XXXVIII and as the founding counselor of McGill University's chapter, **Walter E.H. Massey** feels that he owes his enthusiasm to his experiences at his chapter at MIT.

Following retirement from DuPont Polymers in 1989, **Thomas F. McLaughlin, Jr.** is still working with Montedism and HIMONT USA

developing the new "Spherilene" process for polyethylene.

Long after its occurrence, we have sadly learned of the passing of **Oscar R. Falconi** of Saratoga, Calif., on April 18, 1979.—**Martin N. Greenfield**, secretary, 25 Darrell Dr., Randolph, MA 02368

52

A regrettable misunderstanding led to the mistaken report here last April that **Henry H. Cross** had died. Happily, he is very much alive. We are sorry for any distress the error may have brought to Hank, his family, or his friends. Our thanks go to Lewis Collins, ScD '68, for bringing the mistake to our attention.

There is no hope of a mistake in the shocking news of the death of **Charles H. Ehlers** and his wife, Arlene, in a plane crash on Martha's Vineyard last June 18. Chuck served two years in the Air Force after graduation, and then went to work for Dewey & Almy, a division of Grace Corp., in Cambridge, where he rose to become president of the division in 1975. In 1992 he became president of Grace's worldwide container-products line, based in Woburn. He is survived by his mother and a son and a daughter.

Chuck belonged to the same fraternity, Alpha Tau Omega, as did **Robert F. Welsh**, who retired last August as president of Chevron International Oil Co. The brothers seem to have had a talent for pledging future executives.

We mentioned last month that **Steve Spacil** was thinking of early retirement from GE. After we started that item through the editorial mill, he e-mailed the news that his plans had become final. He retired in August, and intends to be in his house in St. Croix, V.I., in December. We tut-tutted electronically on how few of us use e-mail, and Steve wondered how our classmates manage to keep in touch with the world, and whether they avoid computers, too.

Bob Damon writes that he retired from Olin Corp. in June last year—just after our reunion, apparently—and says that between visiting his four children and seven grandchildren twice a year in Texas and Alabama, trekking in Nepal, and traveling to visit Aztec, Olmec, and Mayan sites, in addition to participating in Rotary, church, and homeowner's association (home is Redmond, Wash.), he has kept more than busy. His wife, Bobbie, he notes, is equally involved. They occasionally take trips separately, though usually together, and as an afterthought he adds that they "do local Volksmarches." Volksmaerchen is German for folk tale, but Volksmarch sounds like what happens after the VW bus throws a rod.—**Richard F. Lacey**, secretary, 2340 Cowper St., Palo Alto, CA 94301, e-mail: lacey@hpl.hp.com

53

I will piece together some of **Gil Gardner**'s old records and fill in part of our 40th Reunion history. (If I miss any of you in this or the next issue, drop me a note.) In no particular order: Audrey and **Joe Cahn**, now living in California where he practices law, joined us for the full four days on campus and on the Cape. After siring four grown children, he now claims to be a bicyclist, skier, boogie boarder, and roller skater. (Tires me just to think about it.) . . . Linda and **Howie Stern**, both looking healthy and handsome, seemed to enjoy all festivities. Howie is chair and CEO of E-Z-EM Co., a publicly held company specializing in radiology accessories. (What kind? Read the firm name phonetically and use some imagination.) His firm and home are in Long Island, and, interestingly, both children are University of Wisconsin graduates.

Berna and **Bill** (aka **Wolf**) **Haberman** are happily ensconced (my word) in Framingham, where Bill, as his major hobby, serves as the commissioner of Public Works, elected citywide. Otherwise, he is completing his 31st year at MITRE Corp., now working on a high-data-rate military communications system. Also, earlier I failed to acknowledge Bill's assistance on the 40th Reunion Committee; thus, a belated "thanks." . . . Our self-described "elder statesman of the class," **Joe Mullen**, and his wife Rita, came from their new home in California; his energy belies his age and makes us all jealous. (Dances well, too.) Needless to say, his work is still far-flung (e.g., Florida and Hawaii) and, joyfully, he and Rita celebrated their 50th wedding anniersary just prior to the reunion. . . . Ellie and **John Rutigliano**, another pair of Californians (now, at least), have a "gaggle" of children (seven) and grandchildren (six). John currently is SR veep of Bentley Engineering Co. and still flies as a hobby. . . . The Reunion was double pleasure for Connie and **Robert Stolow** since only two weeks later they celebrated their 40th wedding anniversary. Their three daugh-

ters have finished school, married, and flown the coop. Robert has spent the last 35 years teaching organic chemistry at Tufts, six of these as chair of the Department of Chemistry.

Julia and **Joseph Stevens** report that he took early retirement in January 1992, after 26 years in the Missile Systems Div. of Raytheon. Now he is a broker with Century 21 in Acton, where he lives, and has a custom picture-framing business. . . . Ruth and **Dick Linde** were their usual happy and ebullient selves (even at breakfast) at reunion. Their hometown, Cliffside Park, N.J., tells the story, since their condo overlooks the Hudson River. While retired, Dick still prepares tax returns for H&R Block, as well as other accounting tasks. Also, he and Ruth have had time to travel, including three weeks in China.

Edie and **Alan Smith**, following his retirement from Monsanto Co. after 31 years, are busily combining pleasure and business by "supplying equipment and services to the sport of orienteering, "via their firm A&E Orienteering, Inc. This venture has permitted them to explore North America, Europe, and Australia. They said it best: "It's a great life!" Jane and **Jack Friedenthal**—also among the California representatives—gives a better description of current events than I: "After 36 years at TRW, with the demise of the evil empire and the subsequent restructuring of the aerospace business, I took the company's bronze handshake and retired. I have no plans at the moment except to stay out of my wife's way, get in some fishing, try to remember how to play golf, and keep in condition by riding my bicycle." . . . Beverly and **Elmer Selby** from Horseheads, N.Y. (near Elmira and Corning), report that he retired in August 1992 from Imaging & Sensing Technology; this firm was a management buy-out company formed in 1988 from a major portion of the Westinghouse Imaging & Sensing Technology Division. Earlier, Elmer had worked 35 years for Westinghouse in various engineering and management positions.

Carol and **Michael Levy** joined in our MIT campus activities; he retired as director of financial planning and operations analysis at Eaton Corp. in late 1992. Their two daughters are married, and one has a grandchild in the "oven". . . . Yet another California couple, Anna and **Harold Tseklenis**, were gay attendees at our four-day MIT and Cape Cod "bacchanalia." He still slaves away as veep at Fluor Corp. in Irvine and has "responsibility for very large [indecipherable] projects in the petroleum field." (Harold, old friend, please type your comments hereafter. Thanks.)

Next month, I will pick up where I left off. Meanwhile, send me news, new or old. But, please be advised that my class notes must be submitted to *Tech Review* three months prior to publication. Thus, don't kill the messenger (i.e., me) for the delay. Finally, Pete, your $1-million House Bank check bounced; please replace it with cash.—**Martin Wohl**, secretary, 4800 Randolph Dr., Annandale, VA 22003, (703) 354-1747

54 40th Reunion

It seems like only a few years ago that we were reporting how many children the various members of the class have. Now, with our 40th Reunion almost here (June 1– 6, 1994), our reports, not surprisingly, are the number of grandchildren. **Dave Whelpley** gives us a complete report: He and Jody have been married 37 years, have five children and seven grandchildren. Dave is the CFO of American Refuse Systems in Pinehurst, N.C. . . . **Jim Hazard** has five children and three grandchildren. He built a sailboat (from scratch) for the grandsons, age 4 and 1, to "help them learn how to sail." Jim is with Scott Paper Co. in Philadelphia, but is thinking about retiring. In the meantime, he keeps active with traveling, tennis and golf. . . . **Marty Brilliant** has a somewhat different approach. He retired from Bell Labs at the end of 1989 but in March 1991 returned to Bell under a contract arrangement. Since then, he has started taking undergraduate economics courses at Rutgers, intending to retire "again" and then get a doctorate in economics at Rutgers so that he can do "research on things I think now are most important." He says that two skills he learned at MIT that he uses very often are sailing (he still has a sailboat) and using chopsticks.

We have received word of the death of **John Romig** last May. John had been a systems engineer director for the U.S. Army Tank Automotive Command in Warren, Mich., until his retirement in 1987. Our sincere sympathies go to his wife, Joan, and their children.—**Edwin G. Eigel, Jr.**, secretary, 33 Pepperbush Ln., Fairfield, CT 06430

55

Since 1969 **Larry Coffin** has been a member of the faculty and chair of the Section of Thoracic and Cardiac Surgery at the University of

Vermont. In 1975 he was promoted to professor of surgery. Under his leadership, the University of Vermont has built a prominent and prestigious cardiac program. Larry has continued to expand the horizons of thoracic surgery, most recently introducing the practice of endoscopic thoracoscopic surgery. He has authored more than 35 scientific publications and is a member of many prestigious national and regional surgical societies.

After holding joint appointments at New England Medical Center Hospital and Tufts New England Medical Center, Inc. for the last 13 years, **Ed Ehrlich** is now devoting all of his time to T-NEMC as VP and executive officer. T-NEMC has grown over the years and now has six businesses and a $14 million annual income. Ed also is devoting time to his role as our class president, and reminds us that our 40th Reunion is not far off. If you have suggestions, comments, or recommendations about the reunion, please send them to Ed at 70 Pond St., Natick, MA 01760.

Several couples got together before the Technology Day Pops Concert last June for an unofficial class buffet dinner. The **Attridges, Greenes, Salibas, Papastrovas, Friots, Klims, Morgenthalers,** and **Ehrlichs** attended.

Last May we reported that among his other community activities, **Jim Eacker** was serving as founding president of the Environmental Fund for Maryland, a federation of 19 environmental organizations seeking access to workplace fundraising campaigns. EFM has developed rapidly, received two foundation start-up grants, and as of July 1 Jim became its executive director.—Co-secretaries: **Roy M. Salzman,** 4715 Franklin St., Bethesda, MD 20814; **James H. Eacker,** 3619 Folly Quarter Rd., Ellicott City, MD 21042

56

Frank Bader is the president of Air Techniques, Inc., Hicksville, N.Y., a manufacturer of dental air compressors, vacuum systems, and automatic X-ray film developers. He has been with the company for 21 years. Frank has three married children and four grandchildren. He resides in Garden City, N.Y.

Thomas S. Hoffman of Charlotte, N.C. retired from Hoechst Celanese on June 30 after a 29-year career. Tom's wife, Dianne, also has retired from teaching math and music. Tom has been consulting part-time. Their three children are employed as follows: Greg (26) is an executive chef in Charlotte, N.C.; Mark (27) graduated from Harvard Business School this past June and will work with the Boston Consulting Group; Julie (28) will complete a doctorate in chemical engineering at the University of Michigan in 1995. Tom will be taking an annual vacation week with fellow classmates and spouses—**Dick Jacobs, Bob Greene, Harry Friedman,** and Mrs. Art Hansen—at the North Carolina shore, as they have for the past six years.

Please send news to **Ralph A. Kohl,** co-secretary, 54 Bound Brook Rd., Newton, MA 02161

57

Please send news for this column to: **John Christian,** secretary, 23 Fredana Rd., Waban, MA 02168

58

Some of the usual reasons given for missing the 35th Reunion ranged from the traditional—weddings and graduations—to the bizarre—a swimming pool collapsing. But the prize winner this time is **Bazil Zingall,** who gleefully wrote, "Retirement is great! Leaving for a round-the-world cruise on June 1st. Will be employed as a male companion (for which I will be handsomely compensated) for lovely widows on the high seas! See what a college education can do for you? Thank you MIT!"

Art Zimmet sent a brief note saying simply, "Had a great time at our 35th Reunion." And that seems to pretty much sum it up for all of us who were there.

John McCartyis currently serving as director, Propulsion Laboratory at NASA's Marshall Space Flight Center, but quips, "In my spare time we've managed to launch four children from college—three engineers and one physical therapist. I'm still active as an MIT educational counselor and sometimes get back to recruit." . . . And from **Phil Sapp,** we received this intergalactic message, "I am now a senior engineering manager at the McDonnell Douglas Space Station Division, responsible for design of the resource nodes on the station."

We were sorry to learn that several members of our class have recently passed away. **Frank Galeener** was a professor of physics at Colorado State University since 1987, and had previously been a principal scientist with Xerox in Palo Alto. Frank had just received the 1993 George Morely Award for contributions to glass science. . . . **Roger Kapp** was a senior VP and chilef counsel for American Home Products in New York. . . . **Richard Thoft** was a professor of ophthalmology at the University of Pittsburgh School of Medicine. He had been honored recently by the National Academy of Ophthalmology for outstanding research on the cornea and anterior segment of the eye. . . . And, belatedly, we learned that **Jack Kesten,** an architect with HBE Corp. in St. Louis, had died. Among his notable works were the renovations of New York's Commodore Hotel into the Grand Hyatt, and the residence of Nelson A. Rockefeller. . . . **Robert Duncan** was a professor in the Department of Mathematical Sciences at Trenton State University in New Jersey. . . . We extend our sympathies to the families and friends of these classmates.

Down in Florida, **Pete Hellsten** is still burning up the professional outboard racing circuit. He was the 1992 national high-point-total champion and also set a competition record of 78.740 mph in September '92. (Note that Pete only carried this out to three decimal places—he must have given up on his slide rule.) . . . Another Floridian, **Eugene Zuch,** has taken the plunge into his own business. He writes, "After nine years with Computer Products, Inc., I have gone off on my own into the consulting arena. I am currently a technical marketing consultant in the Ft. Lauderdale area and am working with several high-tech companies here."

In yet another sign of continental drift, **Art Alexander** surprised me with this news: "After 22 years as an economist with the Rand Corp., we moved from California to Washington, D.C., where I became the president of the Japan Economic Institute, a research and publication organization. As part of the flotsam of the Cold War, I seem to be moving with the tides of international politics." (Hmmm. Hello, *Dr. Strangelove*?)

Time to go—I hear those sleigh bells ringing. Nancy and I wish you all a Merry Christmas and a happy holiday season.—**Mike Brose,** secretary, 75 Swarthmore St., Hamden, CT 06517, (203) 288-3822

59 35th Reunion

The pace of notes from classmates is definitely increasing, perhaps a precursor to our upcoming reunion next June.

Kudos to **George Haymaker** for his appointment in May as president and COO of Kaiser Aluminum Corp. in Houston. Formerly, George was president of Haymaker & Company in Truckee, Calif.

A nice note from **Dave Weisberg** provides an update following his Course I master's in '61. "For over 30 years I have been working in the area of computer graphics and computer-aided-design systems. In the early '60s I was the lead programmer on one of the earliest attempts to apply computer graphics techniques to automated drafting, and was involved in the early use of computer graphics in mapping and process control. In 1972 the focus shifted to the development, planning, marketing, and sales of CAD systems used in electrical, mechanical, and AEC design and in technical documentation while I was with Calma, Tektronix and, for 12 years, Auto-trol Technology. More recently, I have been involved with projects including the Denver International Airport and support of the Space Shuttle." Dave has been living in Denver for 16 years and is also active in the MIT Club of Colorado. In closing, Dave reports founding a consulting and publishing firm called Technology Automation Services, and enclosed a very interesting copy of *Engineering Automation Report,* a monthly newsletter on computer technology for engineering management—call him at (303) 770-1728 for additional information.

Mike Brunschwig provides (via **Al Oppenheim**) a comprehensive and diverse 11-point "chronology" since June of '59, including acquiring a MSEE at the University of Michigan in '61, work at Bendix Aerospace in Ann Arbor and Bendix Missile Division in Mishawaka, Ind., a move to Denver in '65 to work at Martin Marietta doing Skylab and Space Shuttle simulations, a master of business degree from the University of Denver, becoming a CPA in '75, starting his own CPA firm in '83 and selling it in '91, and going to work for his wife's family in '91 as the VP for finance of a pawnshop business. Mike married Geegee Susman in '67, and they have three children (or young adults): Caryn (24), a senior at the University of Colorado; Ari (22), a Stanford graduate now at the Washington University Medical School; and Randy (21), a senior at the Wharton School and planning law school next. Mike concludes with "looking forward to '94 and the Reunion. I talked to **Dave Woronoff** and we're getting together soon. Regards to all our classmates!" Thanks, Mike! As a further note, another source reports that Dave Woronoff lives in Windsor, Colo., where he practices law. He has four grown children plus a 14-year-old and is an avid tennis player.

A note from Al Oppenheim (who has also stimulated and forwarded some of the other notes) opens with the statement that "I got all of my degrees at MIT and then stayed on as a faculty member in the EECS department, which means that except for sabbaticals I've been at MIT for two thirds of my life! What keeps it exciting is the fact that MIT and

EECS are the best in the world, and the world flows through MIT." Al's field is digital signal processing, which he "was fortunate to become involved in in its early days." Al and his wife are heading toward their 30th anniversary next June and have two children, Justine (18), heading off to Connecticut College, and a son (14), heading into the eighth grade. Al's summer messages come from Woods Hole, where 16 years ago he happened to spend a month at the Woods Hole Oceanographic Institution, which has a joint degree program with MIT. He says "I got hooked and our family has spent the entire summer there every year since. This provides the opportunity for research and projects, and for me to indulge my passion for windsurfing. (As windsurfers from the Boston area know, the best sailing is in Buzzards Bay and other places on the Cape, and the high-wind days are so unpredictable that you have to be on the spot and able to cancel any commitments on short notice. The usual line is "about the meeting we had scheduled...unfortunately something's come up." Of course you don't say that what's come up is the wind!) Spending the summers here is like a mini-sabbatical every year." Sounds not too shabby to me, Al! Al also reports seeing former classmates as they come through MIT—keeps in close touch with **Bob Muh,** whose daughter Carrie has finished her first year at MIT, and comments, "when I tell her stories about her father in his wild youth she expresses disbelief since she says he was stricter than any of her friends' fathers. My daughter also claims we're the strictest parents around. Must be a standard teenage line or perception."

A nice message from **Elmer Delventhal** reports that "I'm enjoying participating in Indian Guide camp-outs with son Matthew and in the construction of our new Sunday school (all carpentry, plumbing, electrical work is being done by church members). Looking forward to this summer's New England trip and the chance to meet my oldest son's bride and the newest of my eight grandchildren."

Finally, a note that the Reunion Committee headed by **Jack Fischer.** is alive, well, and actively planning a fantastic experience (June 2–5, 1994, at MIT and at the Black Point Inn on the Maine coast). Also, **Art Colias** has assumed responsibility for the Class of '59's 35th Reunion Class Gift, a new and important initiative for MIT support that focuses on broadening the base of participation in giving. As Art develops this effort, it will involve many class members and will provide even more opportunity to talk with long-lost classmates. Thanks, Art.

That's all for now. Again, I urge you to *actually do it*—to send an update which will be much appreciated by your classmates, and to stimulate other classmates to do the same!—**Dave Packer,** president, 31 The Great Road, Bedford, MA 01730, (617) 275-4056.

60

I do appreciate your responses to my requests for news items, as it keeps me from boring you with repeated pleas and with tales of my personal doings. I threatened that unless you wrote me, I might have to tell you about my Albania trip, but you will be spared that, as well as travelogues on Romania and Bulgaria. Suffice it to say that while there are many things of interest in all three countries, I am not ready to make a permanent move to any of them.

I had mentioned that there were rumors of at least one member of our class being selected for a high post in the Clinton administration. Now it can be said—not that you haven't read about it already (I am writing in late July)—that on July 22 **Sheila Widnall** was nominated by President Clinton to be secretary of the Air Force. Sheila can now include among her many firsts the first woman to head one of the military services. Congratulations, again, Madame Secretary!

From the *Wall Street Journal* comes word that **John Beckett,** president of the R.W. Beckett Corp. in Elyria, Ohio, has been named to the board of directors of ACX Technologies, Golden, Colo. . . . Last month I reported that **Joe Goldstein** had been honored by Lehigh University for his outstanding achievements and distinction in research. Now comes word that Joe has been honored for 25 years of dedicated service to Lehigh. May you have many more happy and successful years, Joe.

Allan MacLaren writes from San Jose, Calif., that he is business development manager for Lockheed Launch Vehicles, Lockheed's entry in the commercial space booster business. Allan is doing lots of travel, having recently been in Spain, Australia, Austria, and Paris for the air show. He said nine customers have signed up for the launch service since the public announcement in May.

Sanford Miller is still in Rochester, N.Y., and still a math professor at SUNY, Brockport. He has recently published his 50th article and continues to enjoy the great outdoors of upstate New York. Sandy's wife, Jill, is a lab

manager at Xerox, and both are avid backpackers, paddlers, and skiers. Daughter Heather has just graduated from Berkeley and is with the Congressional Budget Office; daughter Heidi is a Yale senior. Sandy is looking forward to January and his sabbatical, which he plans to spend in Romania and Japan. Sandy welcomes '60 classmates to visit him in Rochester.

A note from **Daniel Mitchell** relates that he has celebrated 33 years of marriage to his "first wife" (Dan's quotes, not mine) and has two married daughters and five grandkids. Dan is a manager with the Collins Radio division of Rockwell and has two published books and ten patents in power electronics. In addition, he finds time to be an adjunct instructor at the University of Iowa.

From **Linda (Greiner) Sprague** comes word that for the next few years she will have a joint appointment, spending half time at the University of New Hampshire and the remainder at the School of Industrial & Manufacturing Science in Cranfield, England. Linda has been in the UK for the past couple of years and enjoying it. The peripatetic Linda has also been spending time in Hamburg, Germany, as a consultant on Airbus and has been traveling to China, Korea, and Australia as well. She also writes that Chris is the same and living comfortably in a nursing home in Cambridge, Mass.

Finally, from Bedford, Mass., is the news that Raytheon has promoted **Robert Stein** to VP in its Missile Systems Division. Congratulations and continued success!

To all correspondents, thanks, and keep writing.—**Frank A. Tapparo,** secretary and class agent, 15 S. Montague St., Arlington, VA 22204-1007

61

Lo and behold! The e-mail is beginning to pay off! Unfortunately, there was an address misprint a couple of months ago. My addresses below should be correct.

Bruce Bardes tried to get through at the wrong address and, having been rejected, sent his notes via "snail mail." He writes, "Call it mid-life crisis or coming full circle, it's still a career change. I have recently become professor and chair in the Department of Manufacturing Engineering at Miami University (Oxford, Ohio). So it's back to academia, where I started my career, after 22 years in industry. It's also quite a change from the aircraft engine business, where I spent the last 14 years. I have always enjoyed teaching, and I managed to keep my finger in that pie while I was employed in industry by adjunct teaching at nearby universities (wherever I have been living), teaching professional society classes, and corporate classes. My entire responsibility is now undergraduate teaching and administration, for my department offers only baccalaureate programs in manufacturing engineering and engineering management (jointly with the School of Business Administration). Some personal notes: Our son, Eric, a computer programmer/analyst, was married last December; our daughter, Elizabeth, is a semester away from college graduation in language and international trade; and my wife, Eleanor, and I recently celebrated our 32nd anniversary."

From another e-mailer, **Ed Berger**: "A faithful reader of the class news, I found a reference to **Don Hartill** and myself in the July 1993 column. At any rate, it is I, Ed Berger (note the 'r' at the end of the family name), who serves with Don on HEPAP (High Energy Physics Advisory Panel). The family and I have been in Geneva, Switzerland, for the past year. I am doing research (theoretical elementary particle physics) at CERN, the European Center for Particle Physics, while on sabbatical. This is our third long visit to CERN. Bruce, our oldest, graduated from Princeton, class of '91, and is now a graduate student in physics at Cornell. The next, Catherine, will begin her senior year this fall at Yale majoring in biology. Her Yale Glee Club has been on tour in Europe this summer, including a superb performance in a 15th-century church in Geneva this past Friday night. The youngest, Stephen, is 14. His goals were to learn to speak French and to ski well while here this year—both achieved. Would that my accomplishment statement were so easy to write! It is good to read news of the class, but wish I recognized more of the names."

The *Quincy* (Mass.) *Patriot Leader* of July 16 refers to **Fred Salvucci** as a "visionary." This praise comes from his efforts back in the 1970s while Massachusetts' Secretary of Transportation to make a rail link between Boston's two railroad stations. It's an idea that was resurrected last summer in connection with a gigantic road project joining the two stations.—**Andrew Braun,** secretary, 464 Heath St., Chestnut Hill, MA 02167, or via internet: andrewb820@aol.com or abraun@husc.harvard.edu

62

Michael S. Kottler made the news in Salt Lake City with his "crusade to cure America's deteriorating health-care condition," according to the *Salt Lake City Tribune* of May 7, 1993. Michael is both lawyer and physician, and works for the Utah Attorney General's antitrust division. He is putting together a law for Utah that would prevent physicians profiting from their own self-referrals. After getting an SB in electrical engineering (Course VI) at MIT, Michael went to UCLA where he earned an MS in engineering/operations research and then got his medical degree from Case Western Reserve in Cleveland. He recently received a JD from the University of Utah School of Law. Michael was quoted in the article as follows: "I have long been a supporter of a national health program. You hear such threats that if there's such a program you aren't going to get doctors to work. That sounds like a big bluff to me. What are they (doctors) going to do to maintain anywhere near the income they now make? They can't jump, so they aren't going to play basketball!" We wouldn't normally expect such a call for reform from Utah, of all places, but I'm not sure Michael isn't closer to the reality of the national situation than the AMA. As a founder of the Rocky Mountain Eye Center in Murray, Utah, he speaks from personal experience as a medical professional as well as part-time attorney.

A. David Snider, professor of electrical engineering at the University of South Florida, is happy to announce that the second edition of his book on complex variables has come out at last, and that MIT (18.04) is still his biggest customer. David keeps in touch by e-mail, with a real South Florida address: snider@sunburn.eng.usf.edu

Hal Taylor, professor of physics at Stockton College of New Jersey, has recently moved back to his family farm following the death of his father. Hal spends most of his summer

keeping the farm going, and during the academic year he continues to teach physics, astronomy, meteorology, and electronics courses at Stockton. He is busy instrumenting a large new groundwater source heat-pump system being installed to heat and cool the entire academic complex at Stockton. There are 400 wells, each 425 feet deep, filled with a U-tube of 2-inch plastic pipe under a (large) parking lot. Through these pipes (with appropriate manifolding) will be pumped up to 4,000 gallons per minute of water in the closed loop system. Hal expects the system to be operational in 1994. According to the PR hype from the college, the system will save $600,000 per year in electricity for heating and cooling. We hope to keep in touch with Hal to give you future reports on the success of this and other energy conservation projects. Hal keeps in touch via Internet at: htaylor@pilot.njin.net

Jose Alonso has found the convenience of e-mail suitable motivation for sending us some news of his activities. Jose received a PhD under Lee Grodzins at MIT, and then spent four years at the Yale heavy-ion accelerator. In 1972, he and his wife, Carol, PhD '70, moved to LBL (in Berkeley, Calif.) to work with Glenn Seaborg and Al Ghiorso in transuranic element research. He was part of the discovery team of Element 106 (as yet unnamed). Jose transferred to the accelerator division in 1974, and for eight years was operations director for the Bevalac, at the time, the world's only relativistic heavy-ion accelerator. His research dealt with the equation of state of nuclear matter (temperatures and pressures encountered in the interior of supernovae), producing beams of exotic radioactive elements, studying fully stripped uranium ions, and a very active program treating cancer patients with highly effective beams of neon, carbon, and helium ions. Since the closure of Bevalac, Jose has been working principally to transfer the techniques developed for cancer therapy with charged particle beams into the hospital environment. One facility is running at Loma Linda, and two more are planned at Mass General and UC/Davis. Jose is very pleased that he chose such a rewarding field: the application of esoteric accelerator technology to areas that can be understood by the man on the street. Now that we have the e-mail connection (jose_alonso@macmail.lbl.gov), we are certain that Jose will keep us updated on his professional activities and progress improving the human condition.

We are saddened once again to report the passing of classmate **Jerry L. Adams**, who died on June 27, of complications from surgery for cancer. Jerry received an SB in physics with us in 1962, and was formerly president of the MIT Club of Howard County, Md. After receiving an MS from Oklahoma State—where his grandfather had been a member of the first graduating class—and a doctorate from Florida State, Jerry taught at Ohio University (where he also served on the Athens, Ohio, city council) and Roanoke College in Virginia. Jerry then changed directions, moved to Columbia, Md., in 1985 and became a financial consultant for Merrill Lynch. He was active in the Columbia Congregation of the Unitarian-Universalists, and was vice-president at the time of this death. He leaves his wife of many years, Karen, and daughters Alaina, Alicia, and Lori. We appreciate the e-mail message from Phil Marcus, secretary of the MIT Class of 1963, who became reacquainted with Jerry through the MIT Club of Howard County.

Keep those cards, letters, and e-mail messages coming to: **Hank McCarl,** secretary, P.O. Box 352, Birmingham, AL 35201-0352. E-mail contact: MIT1962@mitvma.mit.edu

63

Since I didn't get as much news for this issue as for last, I can be a bit chatty. First, I can tell you about **Dennis Wood**, VI, Burton House, fifth floor. He wrote just before the reunion, but I didn't get his message until just after the deadline, and my last (and first) column here was already too long to include his news. Wait a minute! He wrote June 22nd and that was too late for the October issue?!! Would you believe there is a 4–5 month publication lag (which I'm told is a function of nonMIT aspects of putting the *Review* together). Because of this fact, please rush your news to me or the 'Tute by the first of the month in order to be included in the next issue; then relax for the next third of a year.

I remember an episode of *All in the Family* in which Edith goes to a high school reunion and is asked, "What have you been doing since graduation?" and starts to reply, "Well, the following Wednesday..." This almost applies to Dennis. Anyway, if not the next Wednesday, within a few weeks of graduation, Dennis was hired by Boeing and just now has received his 30-year pin. He earned an MBA along the way. He has worked on the Lunar Orbiter and the Minuteman missile. For the last 14 years, he has managed the development of commercial airplane avionics for the 757, 767, 747-400 and the 777. He married Valerie Sloan 22 years ago. They have two sons, the oldest of whom, Andrew, is a pre-med freshman at Johns Hopkins. Actually, he was a freshman when Dennis wrote; by now he probably is a neurosurgeon. Dennis would like to hear from you at 21845 NE 69th St., Redmond, WA 98053 or at (206) 868-8920.

In other news, **Keith Gilbert**, VI, formerly vice-president, Devices Group of Watkins Johnson Co., was made corporate executive vice-president and also president, Electronics Group. . . . **John R. Brach,** I, writes that he remains at MARTA as director of engineering. His son Brian is a graduate student at Emory University in the P.A. program. John's oldest daughter is a senior at Presbyterian College. He's sorry he missed our reunion. You missed a good one, John; I hope to see you in '98. . . . **Kenneth Klein** writes that he is a PC systems consultant with his own company, K2 Systems, in Norcross, Ga. He has a 3 $^1/_2$-year-old daughter, Shawna, and is recently divorced. He is treasurer of the Atlanta Rowing Club and sculls competitively in his Kaschper single. Kenneth would like to hear from any of his TEP brothers if there are any in the Atlanta area. . . . **Allen C. Weil,** XVIII, was made a partner of KPMG Peat Marwick. Working out of both New York and Valley Forge, Allen serves insurance clients in areas of strategy, mergers and acquisitions, and capital issues consulting.

Larry Miller, VIII, co-founded Portable Energy Products, a company based on his patented portable rechargeable lead-acid dry-cell battery that can be used in laptops and the like. By refining a 100-year-old technology, he developed a lightweight battery that has the same energy density as a Ni-Cad but doesn't have a "memory" effect and costs less than half the price. Although he initially found it difficult to sell an "old technology" product to

venture capitalists, he persevered, and this year his company expects to climb to $700,000 in monthly sales. When are you going public, Larry?

Keep the alumnews coming! As I said above, try to get it to Tech or me by the first of the month. You can reach me by snail mail: **Shoel M. Cohen**, Dept. of Psychology, Nassau Community College, Garden City, NY 11530, or e-mail: Internet 71271.2627@compuserve.com or Compuserve 71271,2627. You can also call me at home at (516) 489-6465. It would be great to talk to you personally.

64 30th Reunion

It is once again my sad duty to report the death of a classmate. **Roy Kidwell**, who was a resident of El Dorado, Ark., died February 22. No further information is available at this time. I'm sure all of you join me in extending condolences to Roy's family and friends.

The rest of the news comes from one newspaper clipping and several Alumni/ae Fund notes. . . . The *Hingham Journal* reported that **Robert Wisleder** was awarded a Silver Medal for meritorious achievement by the U.S. secretary of transportation. He was recognized for his outstanding leadership in the development and acquisition of the FAA's Leased Interfacility NAS Communications System (LINCS). As we travel through the U.S. air system in the future, we can know that a classmate played a key role in its modernization and enhancement.

A note from **Bill McClure** of Louisville, Colo., indicates that he retired from Kodak last year after 27 years and moved with his wife, Lynn, to the greater Boulder area. He formed a company—Eriksen, McClure and Associates—to do consulting and software development to make computers and peripherals "go together like a stereo set." The McClure's daughter Amy (Wooster, '89) is a senior planner for St. Augustine, Fla., and their son Andy (Cornell, '92, ME) is assistant to the president of AustroMold, Inc., in Rochester, N.Y. Bill and Lynn have been seeing Colorado from the seats of a 1959 Jaguar XK150S and love it. They invite classmates to stop by.

Ron Lawson has made four trips to the Middle East since January. He found that Soviet-built electronics abandoned in Kuwait by the Iraqis used vacuum tubes and other components that were obsolete when he took 6.01. Ron's observation is that it's great to find something in this industry that can make someone feel younger than it is.

John Meriwether is now a professor of physics at Clemson University, which he describes as being quite a change from being a chemistry major. "Teaching E&M 30 years after taking it from Hans Mueller in 8.03 is quite a challenge!" He is building a lidar facility in Utah to observe temperatures in the middle atmosphere. With a fellow MIT grad (Fred Biondi, '42), he operates a Fabry-Perot interferometer in Peru to observe winds in the equatorial F region.

James Giffin was promoted to president, chair and CEO of Old Kent in Brighton, Mich. He moved with his family to a wilderness lake in Hartland, Mich., where he and his wife, Jackie, are enjoying country lake living. Son Doug, 22, is recovering from breaking his leg in 44 places in Colorado (skiing, I'd guess) and will be graduating in December from UC/Berkeley in civil engineering. John, 15, will be entering his sophomore year in Hartland.

I don't have any news about our upcoming reunion at this point. I'm sure that by the time the *Technology Review* publication cycle brings this column to you there will have been a mailing or two from the Reunion Committee. In any event, make your plans for sometime and somewhere in June. Meanwhile, have a good winter!—**Joe Kasper**, secretary, RR 2, Box 4, Norwich, VT 05055

65

Dave Dewan stopped by recently. Dave is VP and co-founder of Powersoft, which is focused on software that makes it easy for programmers to do client/server applications. Powersoft is the new name for Computer Solutions, which Dave and his business partner, Mitchell Kertzman, started in 1980. Dave considers himself one of the class entrepreneurs, and we spent most of our time talking about the transition to "working for yourself" that many of our classmates are going through. Dave has maintained a network of people from the class who are also learning how to start and build businesses, such as **Bill Brody** and **Phil Smith**. He says one of the best books he has read in years is *Horse Sense*, which Bill sent him.

Dave got an MBA from Harvard in 1969, and claims that four times the number of MIT classmates have built successful businesses (although Powersoft is unusually successful—Dave's stockholdings were valued at over

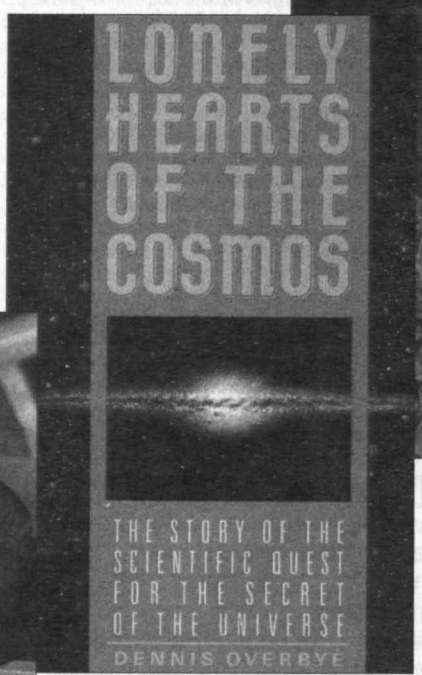
Lonely Hearts of the Cosmos: Tom Hanks' Next Feature?

When Dennis Overbye earned a degree from MIT in 1966, it wasn't in hopes of scientific achievement. "I was a physics major," he says, "but not of the sort that would ever bring any glory to the Physics Department." As one of the country's top science journalists, however, Overbye has put his MIT education to good use. His most notable achievement is the publication of *Lonely Hearts of the Cosmos* (Harper-Collins, 1991), a definitive look at the astronomers who struggle to understand the origin and fate of the universe. Praised by scientists and critics, the book won the American Institute of Physics (AIP) Science Writing Award and was one of five finalists for non-fiction in the prestigious National Book Critics Circle.

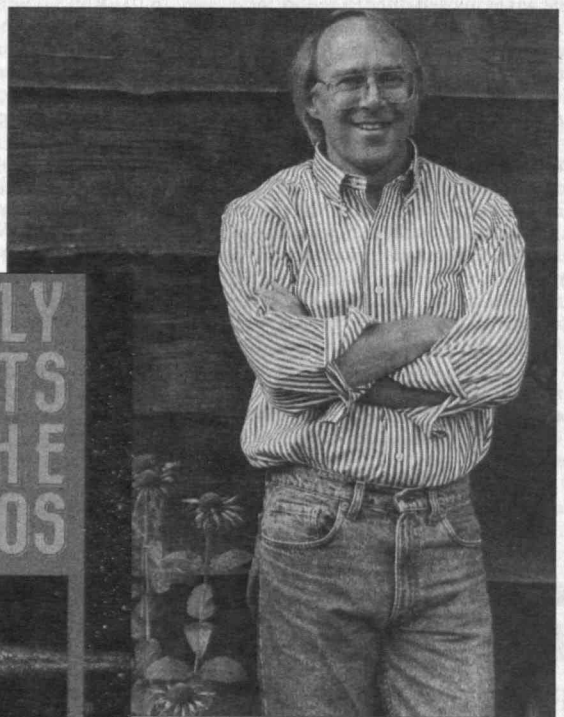
"I was a writer first," Overbye says of his career path. As a Seattle teenager, he founded his junior high school newspaper, but got kicked off "maybe for being in a room where an eraser was thrown, or for writing an editorial calling the principal a liar." At that juncture Overbye set his sights on a career in science, but at MIT he realized he didn't have the the Right Stuff. Of his classmates, he says, "they understood why they were staying up late nights reducing equations and studying the quadripole moment of something, but I lacked the motivation."

Cosmologist Alan Sandage

By 1970, after "some jobs in the military-industrial complex," Overbye decided to give science another try, as a graduate student in astronomy at UCLA. But the road turned when he took a writing course given by a novelist and screenwriter. His classmates "were English majors trying to make connections so they could sell their screenplays," and Overbye started what he calls "a real seventies novel." What was it about? "Everything."



After a year at UCLA, Overbye returned to Cambridge to pursue writing. In 1976 he got his first break, a job with *Sky & Telescope* magazine, the monthly bible for amateur astronomers. After an ignominious start typing up bills for the advertising department, Overbye found himself writing articles. In 1980 he won the prestigious AIP Science Writing Award for one of the first in-depth profiles of Steven Hawking, which appeared in *Omni* magazine. That year, the newly formed *Discover* magazine "made me the proverbial offer I couldn't refuse," and he accepted an editorial post he still holds.



Author Dennis Overbye, '66

By 1986, Overbye was ready for the plunge into book writing. The result was a story as much about cosmologists as about the cosmos. The main character is Caltech's Alan Sandage, the moody, charismatic giant of cosmology who has been at the center of the decades-long effort to chart the expansion of the universe. Overbye saw Sandage's career "as a metaphor for science in general and how hard it is to actually know anything." For a time, Overbye says, Sandage was "almost impossible" to reach. But with patience, they developed a close working relationship that Overbye found greatly rewarding. "He's very courteous and jovial, a

OVERBYE PHOTO: GARY GREEN

delightful guy to talk to. He's outgoing and he's interested in a lot of things, as you would expect of a great scientist. He's a vital man."

Overbye also circulated within the cosmological community. He came to understand that its inhabitants not only resemble other scientists who ponder the universe on its grandest scales but also those who investigate its tiniest. Astronomers keep solitary vigil at their telescopes, while particle physicists "get together in big groups and talk all night, decide what the answer is, and then move on like some thundering herd." Cosmologists, Overbye concluded, are somewhere between. They include observers who comb the universe for newer and weirder findings, and "theorists who are more like physicists—they gang up in Aspen every summer and decide what theories are in and what theories are out."

You might not expect a book about cosmologists to be a hot property in Hollywood, but the film rights for *Lonely Hearts* have been optioned by Tom Hanks, whose star credits include *Big* and *Sleepless in Seattle*. Last year, Overbye arranged for Hanks to attend a cosmology meeting in Aspen. "He didn't understand a word," Overbye says, "but he enjoyed watching them go at each other. . . . Whether it's machine guns or words, it's [still] combat." There's nothing definite yet on the movie prospects of *Lonely Hearts*, but in the meantime, Overbye has begun a book about a scientist with undeniable screen potential: Albert Einstein.—*Andrew Chaiken*□

The author first met Dennis Overbye when both were editors at Sky & Telescope. *With the publication of his book on the Apollo astronauts by Viking Penguin in Spring 1994, Chaiken will follow Overbye into the book-publishing realm.*

$23M at the IPO price) as have his Harvard Business School classmates.

Dave has always been doing his own thing. He started a computer dating company while at MIT that he eventually sold in 1972 and then "retired" for three years while he went around the world. From 1975 to 1980 he was an early principal in an energy consulting firm and then formed Computer Solutions with Kertzman in 1980 to build manufacturing software, initially for time-shared environments and then for microcomputers. In 1988, he ported their software into a client/server environment and had to develop the support tools to make the change. It is the support tools that have become the basis for Powersoft. Last year they sold their manufacturing software business.

This is a key component of a successful small business. Both Dave and I (and many others) have observed that if you can just get started—get good people working in an area—that opportunities present themselves and you can react to build a true, successful company. Debate or comments on these observations are welcome!

Dave married in 1981 (no, he didn't meet his wife through computer dating—he met her the old fashioned way—he was dating her sister). They have two children—a son, Robbie, age 6, and a daughter, Leslie, age 8.

In other news, **Regina Herzlinger** has been named to the board of directors of Deere (the tractor company). This isn't quite as wild as it seems—Regina's expertise is health care, and Deere has become a major provider of health care in the Iowa/Illinois region in which they have plants.—**George McKinney**, secretary, 33 Old Orchard Rd., Chestnut Hill, MA 02167, (617) 890-5771, fax: (617) 890-3489

66

Mark Yogman writes that his son Larry completed his first year at MIT. Larry is in the joint Math/Computer Science program and has followed in his father's footsteps by living in Senior House (only now it's coed). . . . **William Tippett, Jr.**, has left Hewlett-Packard and Colorado to become executive vice-president and COO of Exide Electronics Group in Raleigh, N.C. . . . **Yazan Sharif** has taken a similar position, COO and president, at INDRESCO, a spinoff of the industrial products division of Dresser Industries to its shareholders. Philip Martel, '71, writes that he now works with **Gervasio Prado** at SenTech in Lexington, Mass., a provider of scientific and engineering services in the areas of in-air acoustics and digital signal processing.

Our daughter Erica graduated from Canisius College this summer and is about to embark on a job-hunting expedition. Our daughter Cheryl is frantically studying for her generals so that she may stay in the PhD program at MIT. She and I had such a good time on the Appalachian Trail in Virginia last year (although I did have to hitchhike for the first time since I once hitchhiked across the bridge in 1963) that we are going to try another piece of the trail, this time in Vermont, after her exams. We are hoping for a warm fall.

On a sad note we have two more deaths to report this month. **Kenneth Moore** died in February in Mendocino, Calif. Kenneth worked for the Federal Reserve Bank of San Francisco. . . . **Barbara Coulson Kurtin** called to say that **Janet Romanowych Dingler** had died July 19th of breast cancer. Janet leaves her husband, **John Dingler**, and two sons, 13 and 16 years old.—**Eleanore Klepser**, secretary, 84 Northledge Dr., Snyder, NY 14226-4056, e-mail: vismit66@ubvms.cc.buffalo.edu

67

Please send news for this column to: Sharlotte and **Jim Swanson**, co-secretaries, 878 Hoffman Terrace, Los Altos, CA 94024

68

Please send news for this column to: **Gail** and **Mike Marcus**, secretaries, 8026 Cypress Grove Ln., Cabin John, MD 20818

69 25th Reunion

Hear Ye, Hear Ye, loud and clear! Our 25th Class Reunion is fast approaching—June 2–5, 1994. Please reserve those dates for a smashing good time! By the time you read these notes you will have received a mailing or two from your trusty 1969 Reunion Committee, which has already met several times through July. Sorry to have let you down with the absence of Class Notes for the past few issues. I'll blame that void on the intensity of recent technical and business activity. Hope to make it up to you with a longer column this time.

David Lyon's company, Pacific Communication Sciences, Inc. (PCSI), had grown to roughly $25 million annual revenue by the end of 1992. The company merged with Cirrus Logic Inc. (CRUS). David writes that he will continue to lead PCSI as its president. PCSI is now an independent, wholly owned subsidiary of CRUS (NASDAQ). CRUS was founded by Dr. Suhas Patil, an MIT alumnus and former professor. . . . Dr. **Alan J. Grodzinsky** of Lexington, Mass., was awarded the Ann Donner Vaughan Kappa Delta Award of the American Academy of Orthopaedic Surgeons (1993) for research on cartilage metabolism. In 1993 he was also elected a Founding Fellow of the American Institute of Medical and Biological Engineers.

Paul Kudirka and wife Marcy write that they would like friends from Burton House to know that Paul has joined the Boston patent law firm Cesari & McKenna as of March 1993. Paul has also become a certified scuba diver and has earned rescue-diver credentials. He took son Vincent, 14, to the Florida Keys in July. Vincent became scuba-certified on a family trip to St. Martin in February. Son Joe, 17, is looking into engineering as he plans for college in September 1994. Paul and "college sweetheart" Marcy will have celebrated their 23rd wedding anniversary in August. . . . **Dan Briotta**'s wife, Pamela S. Engram, wrote me: "Dan thinks we met you at the 20th Reunion. Since then two things have happened that we'd like to see in *Technology Review*: 1) Dan Briotta married Pamela Engram of Ithaca, N.Y., August 12, 1990, and 2) Born to Dan and Pamela, a son, Robert Daniel Briotta (class of 2015?). He weighed 7 pounds, 14 ounces at birth and is now over 14 pounds. Hope to see you at the 25th Reunion."

Dr. **Robert A. Sable** is currently practicing gastroenterology as part of a medical group, Riverdale Gastroenterology Consultants in the Bronx. He has been appointed chief of the GI section at St. Barnabas Hospital, also in the Bronx. . . . **Roy W. Haley**, former president

and CEO of American General Finance in Evansville, Ind., has been named COO of the parent company, American General Corporation of Houston. A newspaper account says that American General has assets of $40 billion and equity of $4.6 billion.

Roger Chang writes: "After 25 years, I have gotten back into wrestling! I coach a local team and publish the *Maryland Wrestling Newsletter* for the state Wrestling Association. I also got selected for promotion to colonel in the Army Reserve. I am enjoying being a Macintosh guru for Westinghouse desktop computers and color publishing. We succeeded with the electric vehicle proposal using a Macintosh, which generated a color version in two weeks! That was the same electric vehicle that President Clinton rode in recently! I support over 1,000 computers and twice as many peripherals now. I owe my success to my wife, Lula, who wanted the Macintosh for her business in designing needlework—cross stitch and needlepoint. We now own four Macs, a laser, a color printer, and several scanners. It's a good thing I married a smart woman; she saw the value of productivity over low initial cost."

Speaking of electric vehicles, you should all know that within several years these will most likely be powered by "water engines," i.e., engines generating electricity through steam from the "cold fusion" reaction, which uses the hydrogen in water as fuel (however that stupendous reaction is eventually explained). There are several CF steam generators that are already in development, prototypes of which have now been demonstrated. Toyota is most likely to be the first company to have such a vehicle, though I wouldn't rule out some U.S. companies now in the field. If you haven't seen it, read the cold fusion cover story of the August 1993 *Popular Science*. There's much more to tell, but I'm now a consultant in cold fusion energy and my time is valuable. Best holiday wishes to you all in the New Hydrogen Energy Age!—**Eugene F. Mallove**, secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03304

70

Wesley F. Moore writes from Seattle that, as of early July, he was between jobs at Boeing. He says that he has had a great time designing airplanes for the cover of *Popular Science* at the Military Airplanes Division, but since the "toy shop" is downsizing, he expects to end up fitting military equipment "into commercial derivatives, making my living honestly for a while." His wife, Sandra Walker (Radcliffe, '70) got an MD from the University of Washington in June. They immediately left on a trip to Maui, leaving Amelia, 12, and William, 8, with their grandmothers. "The tropical breezes were just what it took to unwind between the stress of med school and the more intense stresses of residency (psychiatry, in Seattle)." Now he is anticipating our 25th Reunion in 1995. No tropical breezes, but it could be fun.

In New Hampshire, **William Copley** is librarian of the 170-year-old New Hampshire Historical Society in Concord. In June, he gave a talk there on how people tracking their family histories can use sources like cemetary records, church records, and local histories and newspapers. Bill noted that genealogy (the study of family histories) is said to be the third most popular hobby in the United States, after stamp and coin collecting. His library has about 50,000 books, "though nobody knows for sure." If you're in New England, he said, you have to go to Boston to get a better genealogical library.

Bill, who graduated in Course XXI-B (humanities and science), is married and has five children, ages 2 to 17. He said he drifted into his field gradually. After taking a master's degree in American studies at the University of Wyoming, he tried teaching junior high school math and science, then adult education. His interest is working in a history museum, and his life-long love of books led him to the Historical Society.

Write to us and tell us what you are doing—and how you got there.—**Karen** and **Greg Arenson**, secretaries, 125 W. 76th St., Apt. 2A, New York, NY 10023

71

It is my sad duty to announce the death of **Frank Tariello, Jr.** of Schenectady, N.Y. . . . **Alan J. Grodzinsky**, among others, has received the Ann Doner Vaughn Kappa Delta Award for 1993 from the American Academy of Orthopaedic Surgeons. Alan is the leader of the Continuum Electromechanics Group in the Laboratory for Electromagnetic and Electronic Systems at MIT in the Department of Electrical Engineering and Computer Science. He was the principal investigator for the paper, "Physical Regulation of Cartilage Matrix Metabolism."—**R. Hal Moorman**, secretary, P.O. Box 1808, Brenham, TX 77834-1808

72

David Drummond writes, "I have recently been transferred to our company's European operation—Nordion Europe SA in Belgium as director of operations. We manufacture radiopharmaceuticals and other products for the nuclear medicine market throughout Europe." . . . . **Lawrence Bacow** has been elected to the board of directors of Grubb & Ellis Co. in San Francisco. He is an associate professor in Course XI. . . . **Thomas Eager** has been elected to the board of directors of The Nashua Corp. He is a professor in Course III. . . . **Steven Tavan** was married in August to Ms. Ellen Laderman. They are living in Auburndale. . . . **Sarah Simon** joined EG&G's Global Environmental and Ocean Services group in Waltham a year ago and is managing the corporation's internal audit program. "On the not-so-official side of life, my husband, Tom, has designed a 15-foot runabout that was displayed at the Newport Boat Show last June." . . . **Edward Rich** reports, "After 13 plus years at Dow Chemical, including four years outside the US, I have moved back to Midland, Mich., to be corporate treasurer of Dow Corning, a joint venture between Dow and Corning that is a Fortune 500 company in its own right. In addition to worldwide treasury activities, I am also in charge of the insurance department."

On the medical front, **Phyllis Lantos** is still at Montefiore Medical Center "waiting for the even greater challenges that will face the health care industry." . . . **Harry Ostrer** reports that "Elizabeth Marks (Harvard '80) and I were married in June of 1990. In June 1992 we had twin daughters, Lily and Isabel (already the dilemma of which to choose!). I am the director of the Human Genetics Program in the Department of Pediatrics at NYU Medical Center. Liz is a principal in Matthew Marks Gallery." . . . **Ronald Leemhuis** is in his thirteenth year as a family physician in Erie,

Pa. . . . **Gary Stahl** has moved to Cooper Hospital/University Medical Center in Camden, N.J. as associate professor of pediatrics and chief of neonatal services. "Adam is now 11 and Eric is 6. Debbie continues to thrive on the faculty of the Germantown Friends School."—**Dick Fletcher**, co-secretary, 135 West St., Braintree, MA 02184

73

Success has obviously not spoiled many of our classmates. . .at least not yet. . . . **Jim Osborn** is a VP with Brown and Roof. He and wife Becky live in Houston with children Meredith, Megan, and Jimmy. He says he's "one of the few who's still doing what he studied 20 years ago." . . . **Norm Mazer** spent a sabbatical in Switzerland last year as a visiting professor in the Pharmacology Department of ETH (the Swiss MIT). He was recently promoted to VP of clinical research at Theratech, a drug-delivery company specializing in the development of a testosterone patch for hormone deficiencies in men (sorry, he says, no free samples). . . . **Arthur Reidel** has been named president and CEO of Sunrise Test Systems of Sunnyvale, Calif., after leaving Weitek Corp.

M.K. Tulga is living along the shores of the Bosphorous with his wife Esra and two sons, Ali and Kerim. Enjoying his life in Turkey, he sends his best wishes to friends around the globe. . . . **Richard Robison** just finished a PhD in applied linguistics at UCLA. That has kept him busy, along with nine children aged 1 to 17. . . . **William Bron** is living in Los Angeles with his wife, Nadine, and daughter, Rita Carla. They recently traveled to San Francisco and spent time with the families of **Mike Cedars** and friend Richard Stein.

On the homefront, Ruth and JR and I (Eric was at college) were in Baltimore for a game last week to help in the presentation of the Lou Gehrig Award to Cal Ripken, Jr. The award is given annually by Phi Delta Theta to a ballplayer exemplifying the on-and-off-the-field traits of Gehrig (Columbia '25). The ceremony was somewhat jammed into a five-minute time frame a few minutes before the start of the game, but Ripken was a gentleman, shaking hands and signing a ball or program for each of the 20 members of the party as his team escort kept trying to get him back for the game. His class shone through for those in attendance, particularly a 12-year-old boy I've been trying to interest in baseball all his life.

No more important, I have actually gotten promoted within PRC. We were proud to have won the DOD Super-Minicomputer program, a nine-year, $2 billion integration and equipment sales/services award with products from HP, Oracle, and the like. In their infinite wisdom, PRC has made me a section manager for on-site support services for that program, and if you want to know what that means, ask me six months from now. It moves me back to Reston, Va., on the same floor I started with PRC lo, these several years back.

So write!—**Robert M.O. Sutton, Sr.**, secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA 22115

74 20th Reunion

This column comes to you from the decks of the beautiful cruise ship S.S. *Iowa*, the flagship of a new cruise line plying the waters of America's newest and sixth Great Lake, Iowa. Seriously, despite receiving as much or more rain than any other part of the state, Mt. Pleasant had no flooding problems since we are not directly on a river or a low-lying area. Thank you for your calls, though!

Steven Projan received a PhD from Columbia in 1980 and has done R&D for the past seven years for a small biotech company, Applied Microbiology, Inc., which is now profitable. (Please pause for the cheers to die down from everyone out there who's ever had to worry about the bottom line!) He's living in the Big Apple. I also received a copy of a letter Steven sent to the Alumni/ae Fund expressing concern with the balance of emphasis put on research versus undergraduate teaching. His concern is a result of discussions with a research intern he's had this summer from the Institute. He writes, "As a full-time researcher since my graduation from MIT in 1974, I certainly appreciate the value of research and development. However, I believe that the primary responsibility of MIT is the education of its undergraduate and graduate students. In a real sense student education must be the reason for MIT's existence or else we will see it deteriorate into something as unwholesome as the Rockefeller University, where research is an end unto itself, serving the few for the good of the few." Steven is also acting: his fund contributions are being designated to support those faculty who dedicate themselves to student instruction first, last, and foremost. While this editor has his own views on the matter, he shares this with you to get you thinking about, and hopefully acting on, your thoughts on this issue.

A personal note: on July 12 Anna became our legally adopted daughter and Mary and I the happiest parents in the world. When the judge said Anna had all the rights of a natural daughter including inheritance, I had to laugh. Inheritance? She was placed with the wrong parents if anyone is thinking about inheritance.

Until next we meet, keep those letters, cards, videos, etc. coming!—**David Withee**, secretary, 1202 Linden Dr., Mt. Pleasant, IA 52641

75

Please send news for this column to: **Jennifer Gordon**, secretary, c/o Pennie & Edmonds, 1155 Avenue of the Americas, New York, NY 10036, or 18 Montgomery Pl., Brooklyn, NY 11215

76

Please send news. Now!

Frank Ruiz writes, "It doesn't get any better than this—a lovely new wife and a baby on the way (my first, at age 39), all since last year! To top it off, I had a paper published in the *TAPPI Journal*, which lead to a writeup in *Plastics World* on the technology of polymeric film mineral reinforcement—plus a listing in *Who's Who in the South and Southwest* and *Who's Who Emerging Leaders in America*. What else could I ask for?" . . . From **Joseph Tavormina**: "Starting in January 1993, employed as senior manager at Noller Communications, Inc. We are designing a wireless rural telephone system for Indonesia and other developing countries. Telecommunications is essential for development—two-thirds of the world's population has *no* access to basic tel-

phone service. The new system costs one-fifth to one-third of the cost of conventional wired telephone service, including the initial investment. Please call if there is interest in more information."

From **Robert Weinberg**, M.D.: "My son, Joshua David Stein-Weinberg, is now 16 months old and into everything! Between my son, working in two emergency departments in Lynn and Malden, having a family practice at the Boston Evening Medical Center in Kenmore Square, and teaching at Tufts University, I am keeping quite busy. Would love to hear from old classmates. Home phone is (508) 486-4189." . . . **Barbara Donohue-Larson** was running for the Board of Health in Holbrook, Mass. Unfortunately, no one has sent election results. According to the press report, she has been married for the last two years to Ralph Larson of Bolton, Mass., and after 15 years with DEC, is now developing her own engineering and technical writing practice.

Richard Mulligan has received the first American Society for Biochemistry and Molecular Biology (ASBMB)—Amgen Award. He is a professor of biology at the 'Tute and a member of the Whitehead Institute for Biomedical Research. He received the award in recognition of his leading work in the development of new technologies for transferring genes into mammalian cells. His work revolves around using modified viruses as vectors for moving genes. In addition to this award, he had won a MacArthur Foundation Prize Fellowship in 1981, the Scarle Scholars Award in 1983, the 12th Rhoads Memorial Award in 1991, and he was the co-recipient in 1992 of the MIT Science Council Teaching Prize.

David Kessler, M.D., in addition to heading the FDA, was elected to the Institute of Medicine. Election is based upon major contributions to health and medicine, or related fields such as social and behavioral sciences, law, administration, and economics. . . . **David Littleboy** has again written from Japan. He continues to publish the *Expatriate Ledger*, which I believe is a must-read for anyone doing business or investing in Japan. In the most recent issue is an excellent, albeit too lengthy to repeat, article on the Japanese IC and PC markets, among other interesting topics. David's coverage of Japan is quite eclectic, and his political and economical forecasts extremely accurate. David can be reached for subscriptions at his company: Qtech Translation, Ltd., 17-4 Minami Motomachi, Shinjuku-Ku, Tokyo 160, Japan.

In closing, please send news. Write, phone, fax—any medium, but please send news. We always have a need and room for more.—**Arthur J. Carp**, secretary, Quantalytics, Inc., 220 Henley Rd., Woodmere, NY 11598-2523, (516) 295-3632, fax: (516) 295-3230

77

Victor O. Li sent word of his recent accomplishments. In January 1992, he was elected an IEEE fellow; in September of that year he was promoted to full professor at USC; and in June of this year he was elected director of USC's Communications Sciences Institute. So triple congratulations are in order! . . . **Dan Nolet** sent me an informative note by e-mail from his home in Kentucky. He and Teresa, '78, keep busy with their work at Corning and with their two daughters, Catherine and Andrea. Dan is new products manager for the Advanced Display Products Division at Corning. There he works on supplying precision glass sheets used as the substrates for active matrix, thin film transister LCDs, selling mainly to Japanese electronics companies. He wonders if there are a sizable number of classmates who join us in our *Star Trek: The Next Generation* and *Deep Space Nine* fandom.

My news is that I am currently (summer 1993) working on my educational requirements for a state real estate licensure here in Virginia. By the time you read this, I should be an official real estate associate with a major real estate firm. With three children in school full-time this fall (one in private school and another one already in braces), I figured it was high time to start earning my keep (and theirs!). Real estate may be slightly more lucrative than a career in philosophy (my first undergraduate major), pure mathematics (my second SB), or cognitive psychology (my graduate field). We shall see!—**Ninamarie Maragioglio**, secretary, 8459 Yellow Leaf Ct., Springfield, VA 22153-2252; e-mail to hertz@xip.nrl.navy.mil

78

The class of 1978 15th Reunion was a ball, with some 110 people in attendance. Kudos go to **Frances Scovil** and the reunion committee for a job well done.

Karyn Altman Velazquez and husband, Ray, and their three handsome boys were in attendance. . . . **Dave Browne** and wife, Yuko Takagi, were also at the reunion—seen most frequently at Toscanini's Ice Cream in the renovated student center. . . . **Cindy Husmann Berman** and husband, Hal Berman, '76, attended, bringing their three children Kim, Sean, and Dana to the Saturday barbecue. . . . **Rich Perlstein**, Susan Felsenthal, and almost-2-year-old son Michael took time to see Boston as "tourists."

Genie and **Geoff Baskir** came up from Virginia with 3-month-old daughter, Emma, who's a cutie. Geoff later wrote that their return trip home was through thunderstorms that reminded them of their trek home from the hospital with Emma during the "Great Blizzard of '93." Geoff and Genie acquired the requisite MIT kiddie clothes for Emma at the Coop. Geoff says, "Licensing has gotten out of hand with the appearance of MIT 'grunge-wear' (baggy shorts and tartan-sleeve t-shirts) at the Coop."

Ken Lesley and **Cathy Osman** also attended the reunion. Ken is working for UNITECH on contract to the Resolution Trust Corp. Ken says "this is quite a change after running my own computer support services company in California. Being one's own boss even when business is terrible still has advantages over turning in a time card." Cathy is on shore duty for the first time since 1989. She was deployed for both Operations Desert Shield and Desert Storm. She is currently "flying a desk" at Bolling AFB. Son David is 6, 52" tall, and blonde. Sarah is a very healthy 3-year-old who shows no signs of her cardiac condition. Ken and Cathy are also family for three other little boys, so depending on the month, they have up to five kids. Ken and Cathy say "please call or stay with us if you're in the area. We're on the Potomac River across from National Airport and love the view of Washington, D.C."

Mark Bye and his lovely wife, Simone, met while Mark was overseas. They are now living in Emmaus, Pa. . . . **Sue Hansen**, came from Grosse Pointe, Mich., to the reunion. She works out of her home and enjoys life in the Detroit area very much. She and her husband have been getting involved in some community groups. . . . **Milton Roye**, wife, Gloria Lara, and daughter Kathy managed to make many of the reunion events, even though Milt and Gloria had their 10th Reunion at the business school up the river from MIT.

Robe Rosen Marcou came to the reunion sans husband **John Marcou** who was in Jakarta, Indonesia, making arrangements for their family's impending move there. . . . Denise and **Dave Woodruff** also appeared at the Friday night Clambake, and your class secretary and wife, **Diane Curtis**, had a good chat with them. Dave still works with the MIT Industrial Liaison Program, having made some 20 trips to Japan.

The class filled a crew shell with some help from the Class of '63. Mark Bye, Francis Scovil, **Mike Harlan**, **Barb Ostrom**, and your class secretary were in the boat, and found that rowing is indeed like riding a bicycle! The crew paddled leisurely around the Charles River basin, sprinkling a few power-10s in to bring back all the memories. The boat went

very well.

New class officers were elected at the final get-together on Sunday: **Francis Scovil** is president, **Rich Perlstein** is vice-president, **Sue Hansen** is treasurer, **Cindy Husmann Berman** is class agent, and yours truly was re-elected as class secretary. Congratulations to the new crew. The outgoing officers made substantial contributions to class activities over the past five years. Our thanks go to past president **Milton Roye**, past vice-president **Phil Kesten** and past treasurer **Diane Curtis**.

There will be more news from reunion attendees and information on our reunion fundraising in the next column.

We also received some news from classmates through the mails: **Doug Ely** writes, "I'm still consulting to Arthur D. Little, Inc. doing mostly product development work. I'm also doing equipment development and computer consulting for Helping Hands, where my wife, Judi, is program director. (Helping Hands trains monkeys to be helpers for quadriplegics.) Our daughter Rebecca just turned 2, and son Michael is 9 months. They both have more monkey friends than human ones. Judi and I moved to North Andover in April 1992 to a secluded waterfront home in the woods. We love it here."

Spahr Webb says, "I'm still having fun as an oceanographer in San Diego." . . . **Cordelia Price** sends news from Houston, Tex.: "I continue my career with the Rohm and Haas Co. where I've been since I received an SM in chemical engineering from MIT. After spending 10 years in the Philadelphia area, I moved to Houston 2 $^1/_2$ years ago. I manage our chemical engineering department at our Houston plant. I survived an 18-day stay in the hospital for a ruptured appendix last November and five weeks away from work. My department also survived without me. They and I are glad I'm back at work." Cordelia made it to the class reunion.

Peter Jansson was named Young Engineer of the Year by the New Jersey Society of Professional Engineers. Peter is a corporate manager with Atlantic Electric in Pleasantville. He is responsible for the company's 110 electrical substation facilities in southern New Jersey. Peter recently developed, engineered, and managed the utility's Summer Savers Club, a residential and commercial load management program to reduce the need for new plants. Peter has also served as chairman and regional coordinator of Mathcounts, a nationwide coaching and competition program for seventh- and eighth-graders.

Congratulations go to Kathy and **Gene Allen** who had their second daughter in March, named Rebecca Scarlet. Gene says he continues to find work at the National Center for Manufacturing Sciences exciting and rewarding.

Apologies for having missed the last two columns. The demands of the produce farm and two toddlers have far exceeded my expectations.—**Jim Bidigare**, secretary, 9095 North Street Rd. NW, Newark, OH 43055-9538, (614) 745-2676

79 15th Reunion

Deb (McKechnie) Mossman sent me a postcard from Budapest, Hungary, where she was conducting some research on river bends. She reported the weather and food were wonderful and that all of the fruits and vegetables were in season (this was July, mind you). She had even been swimming in Hungary's large lake, the Balaton. . . . **Jonathan Keefe** was expecting his second child in September. At press time, he had just finished leasing an office building in Worcester, having just signed a 100,000-square-foot tenant, and he was looking for a new job. He was also moving to Manchester-by-the-Sea, Mass.

Martin Aboitiz is "still alive and well and living in Argentina. Kene and I are expecting a new baby in September, our fourth. Sold the family business to a multinational company, and they are now my new employers. If any of you have ideas on how to invest the proceeds, let me know." . . . **Sharon Wason** has been appointed the new town planner for Norton, Mass. She had previously been the town planner for Dover. Sharon is a resident of Walpole. . . . That's all for now.—**Sharon Lowenheim**, secretary, 98-30 67 Ave., Apt. 6E, Forest Hills, NY 11374

80

Please send news for this column to: **Kim Zaugg**, secretary, 2384 Leslie Circle, Ann Arbor, MI 48105, (313) 665-2365, vayda@erim.org

81

We end this year with lots of family doings and promotions and other good stuff:

Raising son . . . **Bernie Deitrick** and his wife, Joan, are proud to announce the arrival of their son Daniel, "Class of 2014." We are informed that he's currently undesignated, although "he's interested in everything."

Two careers, three kids . . . **Michelle Lucier Glatz** and husband, Bob, '80, continue to lead "the normal hectic life of the two-career family." She and Bob were expecting the stork this July, which their daughters Shannon, 5, and Brittany, 3, found very exciting.

Peace Dividend? Right . . . We learn that **Guido Defever** is still heading the combustion department at Williams International in Michigan, where he is "surviving the 'Peace Dividend' in the aerospace industry." Speaking of dividends, Guido and wife, Lynda, report the birth of their third child, Mahrie, in April 1992, to join siblings Erin and Andrew. All are doing quite well. Guido has lately sold his Porsche and bought a house, where he's still waiting to hear from **Dino Rinaldi**, who owes him a visit. Hop to it, Dino.

New partner . . . **Stephen Probst** joined Carlisle, Fauth, Gaskins & O'Brien, Inc. as a partner last May. His new firm is a management consulting firm that works primarily in the motor vehicle and transportation industries.

Commanding presence . . . **Francesca Hall**, lieutenant commander, USN, assumed command of the Naval and Marine Corps Reserve Center in Bossier City, La., last May. During the change of command ceremony, Francesca was presented the Navy Commendation Medal for meritorious service. She will also command the Naval Reserve Center in Monroe, La. Francesca's previous assignments include duty as the diving officer on the USS *Hector*, freshman instructor/advisor for Villanova's NROTC unit, administrative department head of a helicopter antisubmarine squad in Mayport, Fla., and reserve manpower officer for Naval Reserve Readiness Command in San Diego.

Classroom excellence . . . Kudos to **Laurie Butler**, chemistry professor at the University of Chicago, who was named recipient of the Quantrell Award for excellence in undergraduate teaching. Laurie let us know that she enjoys teaching very much, but tends to write very long and very hard exams, and she "wouldn't have expected that to be something that endeared me to students!" She's been at Chicago since 1987, and has previously been recognized with an NSF Presidential Young Investigator Award in 1988, a Camille and Henry Dreyfus Teacher-Scholar Award in 1989, and an Alfred P. Sloan Research Fellowship in 1992.

Thanks to everyone who wrote in this year. Happy holidays.—**Mike Gerardi**, secretary, 3372 Olive St., Huntington Park, CA 90255, (213) 587-2929 (h), (310) 553-5050 (w)

82

OK, everybody, if you want to continue to receive news about classmates, we need to hear from YOU. My mailbox has not been getting much activity lately. Also, I check America On-Line regularly. My ID is pdalady. . . . **Scott Davis** writes that he is stationed at Keflavik, Iceland with the U.S. Air Force flying F-15s. He hasn't bumped into too many classmates out there. Next January, he'll be moving to San Diego where he will be doing an exchange tour with the Navy as an instructor at TOPGUN! Wow, maybe he'll run into Tom Cruise!

Bernard Chen graduated from Columbia B-School in '89 and has been working at Banker's Trust in NYC since. He started out in the management consulting group and moved into his current position a year ago running a project management group that oversees workstation-based client-server development projects. He got married last October to a Columbia classmate, Lisa Rudeman, in Hartford where several ADP brothers attended, Dave and Carla Ponn Chin, '83, **Hien An** and Jim Mihor, '83.

Charlie Frankel continues to act. He just did a reading of *To Kill a Mockingbird* and plans to do a play next season. He also writes that **Jon Wade** just got engaged! Congratulations!

Jeffrey Mai passed away in June. No further details were provided.

I'd love to hear from more of you.—**Helen (Fray) Fanucci**, secretary, 502 Valley Forge Way, Campbell, CA 95008, e-mail: pdalady@aol.com

83

Not a lot of news this month, but, as usual, we try to make up in quality what we lack in quantity. . . . **Steven Eppinger** won the MIT Graduate Student Council Graduate Teaching Award. Steven is a professor in the Sloan School of Management, and in the citation his lectures were described by students as "enthusiastic, interesting, and well-prepared." Steven was also noted for being extremely responsive to feedback both negative and positive, and was regarded by one student as "one of the best Sloan professors I've had to date." Wasn't forced dating of professors outlawed years ago?

Linus Kelly writes that he received an MBA from Stanford and is now working as a financial analyst at Allied Signal. . . . **Suzanne Hirschman** writes that she's packed up and moved to England, and she is rapidly catching

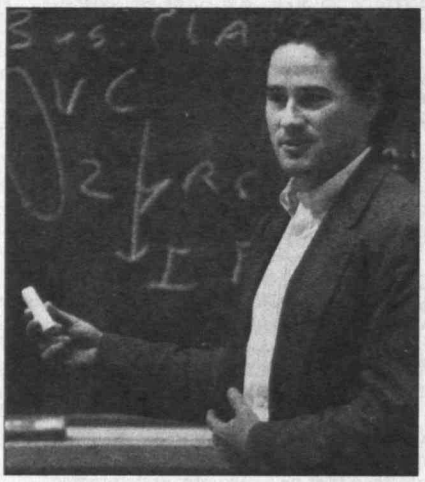
A Slack Economy Is a Great Time to Launch Your Own Company

There are plenty of reasons why right now—1993—is a good time to launch an entrepreneurial venture. The fainthearted may focus on the slack economy and the drying up of both venture capital and bank loans to small businesses. But the fact is that a slack economy creates opportunity, too. This was a theme that emerged among the speakers at a reunion-week panel on entrepreneurship.

The Classes of '83 and '68 joined forces with MIT's Enterprise Forum to mount the program, and the featured speakers were three seasoned entrepreneurs from the 25th Reunion class and a trio of young company founders from the 10th Reunion class. The alumni and alumnae who packed 10-250 for the session testified to the perennial interest of MIT grads in starting their own businesses.

First up was Robert Metcalfe, '68, founder of 3Com Corp. and now CEO of InfoWorld Publishing Co., who noted that people with lots of experience are available in droves for the hiring. And Matthew Haggerty, '83, president of Product Genesis Inc., noted that in some fields, rapidly changing technology offers alert entrepreneurs the chance to leapfrog over established companies. And thanks to the building boom of the '80s, office space can be found on a speculation basis or even for free, added forum moderator Edward Roberts, MIT's David Sarnoff Professor of the Management of Technology.

The group agreed that lack of venture capital is a tired excuse for putting off starting a company. "As far as I can tell, venture capital doesn't really exist . . . and pursuing it is a tremendous time sink," observed Michael Goldberger, '83, founder of MODA Systems Inc. "You end up having a lot of one-way conversations." According to Roberts's database—information on 800 entrepreneurs that was accumulated over 25 years—the average search for venture capital takes 15 to 18 months and consumes 50 percent of the would-be entrepreneurs' time, and in the end only 15 percent of technology companies are successful in that quest. Enterprises launched on a shoestring are much more common.



Entrepreneur Michael Goldberger, '83

The panel identified numerous pitfalls and keys to success that are common to engineers who don an entrepreneurial hat. For example, they supported the oft-heard remark that too many engineers believe that the world will beat a path to their doors if they simply build a better mousetrap. That idea is "a great lie by folks who are twisted and confused," says Kenneth Morse, '68. Morse is founder of several high-tech companies and now managing director of AspenTech Europe. He was once told by a potential client that his pitch was ten times better than that of the competition, but since he refused to negotiate on price, Morse lost the deal. "Generally speaking, companies will not pay much more and frequently will not pay a nickel more for better technology," Morse concluded.

The pros agreed that all start-ups should have some marketing experience on board, an area of expertise engineers often lack. "One of the classical mistakes is to found a company with people just like yourself," Goldberger said. "They may be fun and easy to get along with, but you get more leverage out of people with different skill sets." For the same reason, companies with four or five founders tend to be more successful, Roberts noted. And Daniel Schwinn, '83, founder of Shiva Corp., went even further: "Have a [partner] who likes to hire people he's afraid of."

Successful entrepreneurs are most often driven by the desire for independence and achievement, Roberts said, not just to be in charge. Hence, the panel encouraged fellow alumni/ae with those desires to make the jump from employee to entrepreneur. "If you find yourself saying 'I told you so'—in fact, if your principal source of prestige comes from being able to say 'I told you so'—this is the time to start your own company," Metcalfe quipped. "That's the only way to find out if you're right."—*Kimberly French*□

up on all the rain she missed in California. . . . **Stephen DeFalco** has returned from Denmark. He is working in McKinsey's Stamford, Conn., office. Stephen's wife, Rosemary, just gave birth to their third son, Andrew, who joins brothers Tommy and Stephen. Stephen adds that, when he's not taking care of the kids, he's working on building a house. . . . **Jeff Muss** tells me that he may be finishing up his schooling (finally) after 15 years, next spring. That will be a full 11 years after our MIT graduation date. Is there anyone else who has been going to school on a continuous basis for longer?

Please keep those cards and letters coming.—**Jonathan Goldstein**, secretary, TA Associates, 45 Milk St., Boston, MA 02109

84

Navy Lieutenant **Dennis Sacha** received the Navy Achievement Medal. Dennis was cited for service while in Rota, Spain. Dennis and Denise (née Neirinckx, '87) are now back in the states living in the D.C. area. Dennis is working for the Naval Research Labs. . . . **Michael Drumheller** performed with the Quincy Choral Society and Orchestra in a presentation of Beethoven's *Missa Solemnis*. Michael obtained a master's in voice degree from BU. He sings bass and has performed with the Cleveland Orchestra, Pittsburgh Symphony, Tanglewood Music Center, and others. . . . **Gregory Skinner** received a master of science degree from UCLA back in June 1992. He is currently employed as a researcher for UCLA.

PHOTO: L. BARRY HETHERINGTON

Karen Welch was married in July of 1992 to Thomas Caswell. Hopefully, they are also now proud parents. Karen works at GM and both of them are hoping for a transfer to a much warmer climate. . . . **Tony Smith** is an assistant professor of economics at the Grad School of Industrial Administration at CMU. . . . The 1993 Stanford Business School graduating class included **Michael Cation** and **Gregory Hughes**. Also taking part in the commencement ceremony were 373 other graduates, a toddler, and a golden retriever wearing a bow tie. The latter two did not graduate.—**Howard Reubenstein**, secretary, 28 Mitchell Grant Way, Bedford, MA 01730, 617-275-0213 (home), hbr@mitre.org

85

Hello, everyone. This column is a little late, so I hope we didn't miss a month. Nobody told me this professor job would be so hard.

Local news: **Elizabeth (Johnson) Barnes** lives in the Pittsburgh area with husband, James, and is the proud mother of Sara (2.5 years) and Jerome (6 months). She is a manager in the Management Consulting Services of Price Waterhouse. She is also secretary of the board of directors of the MIT Enterprise Forum, Pittsburgh Chapter.

Brian Carty is joining a family practice group in Fairfax County, Va. He recently had a mini-reunion with Sonya Sakai, '86, Sofia Merida, '87, and Chris Andrews, '89, during a trip to California. . . . **Lars Rosenblad** participated in the Marion-to-Bermuda race in June. . . . **Midori Yenari** is still at Stanford Hospital completing a neurology residency. She will remain there for two more years as a stroke fellow.

Roy Petekofsky is in Washington, D.C. He was recently promoted to manager of operations research at USAir where he now supervises 15 people including two MIT PhDs. He has also been playing keyboard professionally with various rhythm-and-blues bands around D.C. In September he will be spending two weeks in China. . . . **George Seelinger** and wife, Roberta Seelinger Trites, had a son, George, on May 26 and moved to a new house on June 4. Might as well pack all the stressful events together.

Send news to **Bill "Dr. Amazing" Messner**, 5927 Alder St., Pittsburgh, PA 15232, (412) 361-4180, Internet: bmessner@andrew.cmu.edu

86

Sparse news this month. **Kim Hunter** is still involved with BKTF Enterprises, Inc., DBA Hunters' Yarn and Needlework, and Merrill's of New England. Both are based in Meredith, N.H. although she still lives in Hanover. Kim is also freelancing as a manufacturer's sales rep for several companies in the needlework industry. . . . **John Port** has completed a PhD in neurospace, with an MD to be done in one more year. Then he'll be off to make a living doing "rays"—radiology. No kids yet but they're slowly getting used to the idea.

Dave Milli rejoined Price Waterhouse in January 1992 and has lived in Milwaukee, Wisc., since then. He's working on a computer installation project for the Milwaukee County Jail: "It's been interesting," Dave writes. . . . **Derek Barkey** is working for McDonnell Douglas Aerospace in Long Beach, Calif., doing structural analysis for the High Speed Civil Transport. He lives near Disneyland with his wife and two cats. . . . **Bill Hobbib** moved from Illinois to Massachusetts last August to take a marketing position with Cognex Corp. Cognex manufactures machine vision systems—hardware and software which can replace human vision in manufacturing processes. He bought a house in Newton and is keeping busy with job, home improvements, musical activities with several choral and community theatre groups, and editing the MIT Club of Boston's newsletter.

Congratulations to **Mary (Bayalis) Prettyman** on the birth of her new son, Drew. Both Mary and her husband work at McDonnell Douglas in Long Beach, Calif. She is in aerodynamic design for commercial development programs (MD-12, MD-XX). Mary hopes that one day these'll be more than paper studies and they'll actually get to build hardware. **Bill Hobbib, James Person** and **Suzanne Dunbar Person, Derek Barkey** and his wife, Kelly, and Lyle Menzel, '85, and his wife, Ann, have all stopped by to see the new addition. Mary visited **Gabrielle Hect** in the Bay area. Gabrielle just landed a teaching position at Stanford in history of science.

By the time this article goes to press, I should have a new addition myself. We're due Nov. 18 (not nearly soon enough!). Keep the letters coming.—**Mary C. Engebreth**, secretary, 21305 Arrowhead Court, Ashburn, VA 22011, (703) 729-6568

87

I'm pleased to announce that the Class of '87 has gone "high tech" with its own electronic mailing list! Subscribers to this list will receive a "pre-publication" version of this column about two months before it appears in *Technology Review*. I'll also use the list from time to time to remind you to send in your Class News for the column. So far, we have more than 90 people on the mailing list, and the response to the initial mailing has been pretty good. To subscribe to the list, all you need to do is send me your e-mail address—spread the word to your friends!

Greer Tan Swiston checked in with lots of news from Boston. She and her husband, **Rob Swiston** celebrated their first anniversary this past June by spending a week in St. Maarten. Greer is working at Fidelity Investments now, while Rob is still at FASTech Integrations. Active in the Society of Women Engineers (SWE), Greer just finished up a year as president of the Boston section. This year, she is concentrating on a new SWE-sponsored mentorship program for women on AFDC (welfare) who may be interested in engineering, and invites alumnae in the Boston area to contact her for information. In describing the program, Greer says that the mentors are "... actually more like role models than mentors, because the participants mostly offer moral support. This can make a difference; however, as the (AFDC) women are generally bright, capable, and hardworking, and just need to hear some positive support to counter all of the negativity, misfortune, and dehumanization that usually surrounds them...." Greer and Rob recently went to a party at **Eugene Pan**'s house, where they saw **Stan Oda** and his girlfriend, Gina. Eugene is making plans to attend medical school, having scored well on the MCATs. Other classmates they heard from include **Toai Doan** and **John Canfield**, both recent DEC defectors. Toai has moved out to the Canoga Park area of Los Angeles, and John is planning to attend Stanford Business School in the fall. Also in L.A., **Dan Margolis** was supposedly married this past March. As no details are currently available, his PBE fraternity brothers are requested to write in with pertinent information. **Sofia Merida** is doing well at JPL and at volleyball, where her team just won the league playoffs this year! While grocery shopping, Greer bumped into **Mimi (Ing) Slaughter**, who lives in Westin with Frank, her husband of five years. Finally, Greer is interested in the whereabouts of **Susan Fields**, who supposedly lives somewhere on the West Coast.

Julia Gessner reports that she left DEC last year to get an MBA at INSEAD in Fountainebleau France, just outside of Paris. She just graduated this past June, and will let us know what her future plans are. . . . **Sharlene Liu** is in Sydney, Australia on a three-month summer sabbatical from PhD work. She found a position at Australia's National Acoustic Lab, doing research on speech processing for hearing-aid applications, and reports that Sydney is beautiful (very California-like), and that the weather and people are great down there.

Jonathan S. Kane has also spent time in Australia recently, having taken three months to bike through that country. Jonathan received an MS in electro-optics from Tufts University, and is currently pursuing a PhD in electrical engineering at Boston University. He is also spending time getting ready for his wedding, as he will be marrying Arlene Agosto on August 8.

From Lausanne, Switzerland, **Patrick Kim** says that things for him and his wife, Estelle, are "pretty good. Estelle is continuing her piano and voice studies at the Conservatory, while I'm working my way to a PhD in materials science at the Swiss Federal Institute in the area of composite materials processing...." Though a change from his original field of soil mechanics, Patrick says that he still stays in touch with it via the large vegetable garden that they have planted. **Mark Hessler**, who just spent a few days in Lausanne, recently finished a semester tutoring the son of the Aga Khan, and is now back in the United States. Mark enjoyed Lausanne so much that Patrick says that he wouldn't be surprised if Mark wrote in saying that he found a job on the Cote Vaudoise. Patrick's brother Eric Kim will be arriving in Europe shortly to start an MBA at the College des Ingenieurs in Paris this Fall.

Grace (Ueng) Trombetta sent me a fax that adds some details to what was in last month's column. In 1991, Grace married her husband, Patrick, graduated from Harvard Business School, and moved to Minneapolis to work in marketing for General Mills. Last fall, Patrick was transferred to the Bay Area, and Grace found a job there working with the Clorox Co. in the area of brand management.

Heather Beck writes that the biggest "doing" in her life is that she is getting married on August 7th to Dan Abushanab (Virginia Tech '89), whom she met at Berkeley while working on an MS in mechanical engineering. The couple will be taking a two-week honeymoon to France after the wedding, and expects that one of the many MIT friends attending the wedding will write in to this column with the details. Heather is currently back at the 'Tute working on a PhD and hopes to graduate sometime next year. She is working in the Biomechanics Lab with Professor William Durfee, SM '81, PhD '85 (who will be leaving for the University of Minnesota at the end of the summer). In addition, Heather is serving as a co-president of MEGAwomen, an organization that provides support and networking to

female mechanical engineering graduate students. In addition to helping the department improve some of its orientation activities, the group spends time encouraging undergraduate women to attend graduate school.

Tony Mercado writes that he is engaged to Juli Blumenthal (Yale '86), with a June 1994 wedding planned. Having recently left AT&T, Tony now works for Lehman Brothers in the Fixed Income Analytics Department, where his office overlooks the site of the World Trade Center terrorist bombing.

I received a letter from **Rossana (Chiang) Lin** and **David W. Lin**, who proudly announce the birth of their first baby, Caleb Michael Lin, on June 23. Weighing in at 6 lb. 6 oz. and measuring 19 inches long (that's 2.90 kg and .4826 m for MKS fans), both Caleb and his mom (and dad!) are doing fine. Rosanna and David were married in Boston in 1988, and moved out to Southern California in 1989. David works at Tektronix as a systems analyst, while Rosanna is taking a break from her job as an applications engineer with Frame Technology to care for the new arrival.

Patrice (Hornsby) Allen reports that there is lots going on in her life. While working at the Albert Einstein College of Medicine, she got an MBA at Long Island University in the area of general management, graduating first in her class! She and her husband Tyrone are expecting their first child this November, and are "real excited and having fun getting ready for the new addition." They plan to be in the New York area only until next June or July, after which they will "be off to another military base somewhere else in the world."

Finally, from the Alumni/ae Office, we hear that **Peter A. Donis** has joined the board of directors of Giddings and Lewis, Inc., of Fond Du Lac, Wisc. Also, **Andrew Plump** received a PhD from Rockefeller University in New York in the area of biochemical genetics and metabolism. So that's it for this month! Thanks for your great response, and don't forget to send me your e-mail address if you want to join our electronic mailing list!—**Jack Leifer**, secretary, 2703 Swisher St., #202 Austin, TX 78705, tel: (512) 472-7507, fax: (512) 472-7546 email: leifer@ccwf.cc.utexas.edu

88

Hello Class of '88. I would like to reintroduce myself. My name is **Cathy Suriano Singer** and I am your new class secretary. For those classmates who missed our fifth-year reunion blast, here's the scoop on some of the many classmates who were there. . . . **Carlos Franceschi** was sporting his new beard. He is an account services specialist at IBM and recently traveled to Germany and England. . . . **Martha Soto** has been teaching bilingual science at Cambridge Rindge and Latin High School and is now a graduate student at Harvard majoring in biology. Martha and Alan Szarawarski were married last June. Alan is also a graduate student at Harvard, where he is majoring in government.

Ellen Burmenko Plotkin graduated from Rutgers University Law School and is pursuing a career as a patent attorney at her new firm, Hopgood Calimafde Kalil Blaustein & Judlowe. Ellen married Alex Plotkin in 1990. . . . **Tom Spitznagel** received a PhD in chemical engineering from Berkeley and is now employed at the Genetics Institute in Andover, Mass. Tom enjoyed his drive across the country, especially his stop in New Orleans. . . . **Barbara Sannwald** now lives in Denver, where she is a consultant for Oracle. She does lots of traveling to exciting places like Kansas City.

Alan Sbarra flew in for the reunion from Miami. He is a sales and route analyst for United Airlines' Latin America division. Alan does not have too much class spirit, since he refuses to supply us with free tickets. . . . **Aimee Burnstein** is currently working on a PhD in clinical psychology at Adelphi University on Long Island. . . . **Greg Bonafede** is also on Long Island, where he is working on a master's in English at Stony Brook. Greg is an Air Force captain and has spent the last four years in Texas. Greg is looking forward to teaching English at the Air Force Academy after finishing his degree. . . . **Dan Dilorenzo** came to the Friday night party at Baker, but had to leave early and meet with the rest of his Fiji pledge class to attend Shane Arnold's wedding in New Jersey. Dan is working on a PhD in electrical engineering at MIT.

Nancy Perugini came to the reunion with her fiance, **Dave Riggs**. Nancy works at the IBM TJ Watson Research Center, where she was promoted to staff engineer. Nancy and Dave just bought a house in New Fairfield, Conn. Nancy paints in her free time and is aspiring to be the next Georgia O'Keefe. . . . Other engagements include **Larry Candell** to Amy Bertin, '87, and **Gerald Cohen** to Elizabeth Brandwein. Congratulations to all!

Arlene Shames Bernhardt graduated from Wharton and is now a systems analyst at Credit Lyonnais. Arlene and Marc Bernhardt were married in June 1992. Arlene's sister Miriam, '91, was the maid of honor. . . . **Marcos Esterman** attended the class reunion with his "special friend" Ann. Marcos lives in Milwaukee, where he designs X-ray tubes for GE Medical Systems and is working on a PhD at Madison. . . . The youngest guest at the reunion was **Nirmala Panicker Thomas**' and husband Antony Thomas' newborn. Adam Rosen writes that he is working at Bose Corp. as the in-house recording engineer and soundtrack designer. Adam finally broke down and moved out to the 'burbs. . . . **N. Darius Sankey** received a PhD in optics at the University of Rochester and joined AT&T Bell Laboratories in Murray Hill. Darius welcomes friends in the class to give him a call if they want to hang out in New York City.

Scott McFarland married Becky Watercutter on July 3 in Plymouth, Mass. They will honeymoon in Nova Scotia. Many of Scott's SAE fraternity brothers attended the wedding, including **Jim Casamento**, who is now at Polaroid working on the production of laser diodes. Jim also gave the following details. . . . **Tim McGonagle** is at NCR in Colorado. . . . **Bill Kennedy** is starting a company developing a network of cellular phones for trucking companies. . . . **Jim Burch** graduated from SUNY Brooklyn Medical School and finished his internship at Salem Hospital. He is now working in radiology in Albany, N.Y. . . . **John Griffith** is at NREC in Woburn, Mass., where he is developing medical instruments for endoscopic surgery. . . . **Anthony Fortunato** is at Morgan Stanley.

I have spent the last five years working in the optoelectronics department at IBM in East Fishkill, N.Y., during which I received a master's from Columbia University and my first patent. I am now married to Andy Singer, '89 (a PhD student at MIT), and recently started working at Lockheed Sanders.

I am really looking forward to hearing from each of you, so please write or send e-mail.—**Cathy Singer**, secretary, 131 Main St., Andover, MA 01810; e-mail: singer@athena.mit.edu

89 5th Reunion

We'll start off with some reunion news. The reunion committee is forming now (as of late August) and by this time should be together and well into the planning stages. So, it's not too early for everyone to begin planning on coming to the reunion. Graduation is May 27, 1994, and the reunion will take place from June 2–5, 1994.

I've gotten a few submissions for the class calendar, but I still need to beg for more, so please send those pics in! There is also a new submission format, video tape (either VHS or 8 mm). All submissions will be returned. We'll be publishing the school-year calendar, which will feature pictures of classmates, families, and other alumni/ae events, shortly after the reunion.

Here are this month's list of people to please write in: **Paula Aqui, Jeff DeRosa, Susan Lee, Michael Roberts, Kevin Tow.** What are y'all up to? If anyone knows about any of these people or anyone else, please write in!

Rebecca Smith is happy to be back in Idaho after a short stint in Florida. Rebecca was married on July 10 to Gaylon Lords. . . . **Cecilia Taylor** is working for Merck & Co. in Somerset, N.J., and recently received a promotion to senior process engineer. . . . **Claudia Ranniger** married Craig Wanke, '88, on August 8th.

Jeff Berg is employed by the UC Lawrence Livermore Labs, and is involved with a project sponsored by the European Space Agency known as "X-Ray Multi-Mirror Mission," an X-ray satellite observatory to be deployed by ESA to investigate various stellar phenomena. Jeff recently joind the MIT Club of Northern California.

Ross Snyder passed the bar exam after graduating from the USC Law Center last year. Ross is now living in Glendale, Calif., and is an attorney with the law firm of Hecker & Harriman, which specializes in patent law, particularly that relating to electronic and computer-related inventions.

Bruce Horton is working as an architect and structural engineer for the Austin Co. in Cleveland, Ohio. . . . **Marcia Smith** finished her first year at UC/SF, and she and **Tim Steele** were maid of honor and best man at **Jean Kim** and Rick Giarrusso's August wedding. They all picnicked at Angel Island this summer, along with Steve Smoot, '90, Jai Young Kim, '90, and **Dave Miller.**

Eric Tang has switched jobs and is now working at Parallan Computer, Inc., in Mountain View, Calif. Eric will help with fault-tolerant network file servers for IBM machines.

Alice Paquette is in the Neurosciences Graduate Program at UC/SD, studying developmental neurobiology in a lab at the Salk Institute. Alice has an NSF Graduate Fellowship and is finishing her second year. She is also wondering what all the people from Random Hall are up to, since they never write to *Tech Review* (yeah, write in!).

Anh Thu Vo recently attended **Rachel Kaminer**'s wedding, and saw a lot of old classmates. Rachel was married to Brian Gebhardt on June 13. The Jewish ceremony was complete with the signing of the Katuba and the recital of the seven blessings. Rachel is currently teaching middle school in New Jersey. She has also started working on an MEd. Also in attendance were **Elliot Marx**, Robert Silbergleit, '88, **Joseph Orso**, Donna Giordano, **Ann Mailhot**, John Mailhot, '88, Lieutenant j.g. Chris and Lieutenant Beth (Jones) Neils, (both '90), and Kevin McMahon, '91. Elliot is cur-

rently working at American Power Conversion in Billerica, Mass., and reports to be single, making a try at karaoke, and DJ-ing. Robert is an MD in Emergency Medicine Residency in Philadelphia. Joseph and Donna are also in Philly, where Joe is working as a helicopter rotor-blade stress engineer at Boeing. Joe earned the nickname "Crash" by killing two cars since graduation, and is "doing his best to kill a third auto." Ann is a production manager for wafer fabrication at Bertram Labs, and has been married to John for the last four years. John is now a supervisor in the HDTV group at AT&T Bell Labs in Murray Hill. Ann and John recently bought a house in Somerville, N.J. Chris is still designing submarines at Naval Reactors in Arlington, Va., and Beth is planning the logistics of moving an Army battalion from Alexandria, Va., to Aberdeen, Mass. Beth and Chris have been married three years, and will be rowing again this summer. Kevin is working at Centerline Software in Cambridge. Anh, who was one of the bridesmaids (and apparently appointed secretary) is working as an associate systems engineer for the Grumman Space Station Integration Division in Reston, Va. Anh says that their contract has been up in the air recently, due to the redesign effort and the ensuing political battles. Anh has been rock climbing to help her get rid of her daily frustrations, and invites people to look her up if in the D.C. area. Rachel has also been planning a reunion for the IOTA RHO/MIT Women's Novice Crew of '85 (let's hope they're all planning to attend our reunion next June!). To contact either of them, call the Alumni/ae Records office at (617) 253-8270 for their (or anyone else's) address and phone number.

A number of people couldn't make Rachel's wedding, but sent congratulations. **Kia Freeman** is living and working in San Diego, Calif. **Debbie Falcone** has just finished an MS at Stanford in Mech E, and **Mike Fincke** has just been accepted to Flight Test Engineering School at Edwards AFB in Calif. Mike Dickens, '90 is working for BBN and living in Cambridge. . . . **Barry Bassin** is working for Dunlap and Associates in Norwalk, Conn., and Lieutenant **Lawrence Galler** is living in Oahu, Hawaii. He is currently serving on the nuclear attack submarine USS *San Francisco*.

John Martin, who started business school at Kellogg in September, writes in to lets us know how some Dekes are doing. John attended Irene and **Steve Stoller**'s June 20th Long Island wedding with **John "PC" Lyszczarz, Jerry "Snowman" Grula**, Todd Sachs, '90, Mark Candon, '90, Jon Kane, '87, and **Bib Puglia**. Bib did a rendition of "Gilligan's Island," which he is hoping to redo at Beth and **Jerry Grulas** October wedding. Bib is now over in Prague heading up a new office for his company, which does probabalistic analysis of nuclear power plants. Steve is still up in Boston, contemplating the Red Sox chances and B-school. Dr. John L. is now a doctor of psychiatry in San Diego. **Dewey Ennis** graduated last year from MIT, and **J. D. Harrington** is out on the West Coast "terrorizing women with his Marine uniform," as John puts it. John continues that "we are all looking forward to the five-year reunion, and plan on stopping by Simmons during that weekend."

Well, that's it for this month. Thanks again to everyone who wrote in, and start planning those reunion trips!—**Henry Houh**, secretary, 4 Ames St., Cambridge, MA 02142, phone: (617) 225-6680, fax: (617) 253-2673, e-mail: tripleh@athena.mit.edu or henry_houh@mit.edu

90

Tami Jacobsen has recently announced her engagement to Tom Dalton. Tami and Tom met in New York and are busy planning a 1994 summer wedding. In the meantime, Tami has also left her job at IBM to start Arizona State University Law School. . . . On May 29, **Ann Rhee** eloped with **Matt Katz** in Las Vegas. . . . **Arnold J. Smith** is now principal engineer/section manager in PC Development Engineering at NEC Technologies, Inc. . . . **Renata Pomponi** is in the TPP program at MIT. . . . **David Yosick** received a master in architecture degree from the Harvard Graduate School of Design in June 1993. . . . **Robert Dunlay** will be attending Stanford this fall for a master's in computer science.

Some international news. . . . **Mark D'Agostino** is in Nigeria working for a computer systems company. . . . **Amos Leung** had the chance to tour the Porsche and Mercedes-Benz plants in Germany, where he was vacationing last spring. . . . **Lisa Lozo** saw Jean-Claude Van Damme and Gerard Depardieu while vacationing in Rome, where she also met up with **Tuney Kuru, Shanthi Muthiah**, and **Sophia Mangatel** in Barcelona and Paris. Lisa is now working in Antibes, France, at Cordis, a biomedical company that makes catheters. . . . After three years at Mobil Research & Development Corp., in New Jersey, **Flora Feng** is quitting to spend the summer studying Chinese in Taipei, Taiwan, and then starting studies at Georgetown University Law Center in the fall.

Rachel J. Bishop writes that she has served the last three years as a medical service corps officer in the U.S. Army, stationed in South Korea and San Francisco. She has just returned to the Washington, D.C., area to complete premedical studies and is planning to head off to medical school in 1995. Rachel mentions that she's been in touch with **Elizabeth Williams** and **Veena Trehan** who are both doing well.

Congratulations to Class of 1990 fathers-to-be **Brian Eastley** and **Craig Pastrone**! Brian and his wife, Tiffany, have also just celebrated their second wedding anniversary and are excitedly expecting the birth of their first child. Brian has been working as a patent examiner at the U.S. Patent & Trademark office in Washington for the past three years but is planning on beginning an MBA program in the Boston area in the fall. Craig Pastrone is about to be the proud father of two! Craig and wife Krista Breed ('89) are expecting their second child in September 1993.

Some news from fellow Bakerites: **Alex Gorodisher** is developing new methods in vibrations and acoustics in the Advanced Vehicle Development Department at Ford Motor Co. in Dearborn, Mich. . . . **Chris Fennema Notestine** just passed the PhD qualifying exams at UC/San Diego and spent some time in Hawaii relaxing. . . . **Billo Naravane** received a master's degree from Stanford and is engaged to be married to **Jon Cooper** on August 28, 1993. **Penny Plummer-Fusco, Lisa Czernorka**, and **Rose Rocchio** will be bridesmaids at their wedding in New York. . . . **Desmond David** has just returned to Houston after a short vacation in Boston, where he met up with a bunch of alums including **Meryl Alford, Nikki Skinner, Max Ochoa, Maureen Kenneally, Don Euwart**, and **Beth Kulas**.

Special thanks to **Eddie Hernandez** for putting me in touch with recent MIT alums at Ford Motor while I was in the area for the summer. Apparently, many people at Ford think MIT alums are forming a conspiracy to take over the company—perhaps they got that feeling after someone saw the massive Ford/MIT alumni internal e-mail distribution list! Eddie is now working as an intake manifold engineer for the 1996 F-150. He and **Cyndi Downey** were married July 3 in Orlando, Fla., and have settled down in Plymouth, Mich. Eddie and Cyndi have been keeping busy in the Midwest, traveling to the Indianapolis 500, Gold Cup Hydroplane Race, Detroit Grand Prix, and Trans-Am Race!

Hope everyone has a wonderful holiday season! Please write and let us know what you've been up to! Please note that once again I have moved and have a new address. Send news to—**Ning Peng**, secretary, 483 Beacon St., #41, Boston, MA 02115 or ning@athena.mit.edu.

91

"Greetings! (but not from Kiev)," writes **Terry Totemeier**. "Although I am sending this postcard from Cambridge, in the United Kingdom, where I'm in the midst of my PhD work, I was in the Ukraine in June for a conference. I don't recommend it as a tourist attraction!" Terry married Ann Bening (Wellesley, '91) in September 1992. "I've been in England now for two years," continues Terry, "and am only now beginning to talk a little funny. I still keep in touch with **Andy Parsons** and plan to return next year." . . . **Seema Nundy** has finished a master's in artificial intelligence in education. She began work on a PhD this fall at the University of Toronto. Seema is also involved in starting a fellowship program to send people to South Asia to do development work for five to six months. She spent August in India doing data collection and research.

"Things are rad out here in sunny Santa Monica!" writes **Alan Blount** on a postcard featuring the famous pier. "I'm working at Cambridge's own Metriplex, but you'll never believe what I'm doing this summer—I've been a kelp farmer working off the Honduras coast. Soon it's back to the old computer science grind for me." . . . **Sabrina Tellalian** married Minor S. Huffman III, '88, in June. **Cosette Gutierrez, Sharra Davidson**, David Huntley, '88, and Shawn Banchik, '88, were in the wedding party. Cosette is beginning work on an MBA at the University of Indiana, and Sharra works for Merrill Lynch in the public finance area doing municipal housing bond structures. Sharra reports that other attendees at Sabrina's wedding included **Owen Bayside; Yang Chen**, who works for Prudential Securities in New York City; **Steve Colten**, who is at First Boston in New York City; **Ann-Marie Beals**, who works in Manhattan; **Ken Shimberg**, who works for a New York investment bank; **Lauralee Grizzaffi**, who is working in Florida; **Paul Antico**; Will Botti, '90; Sean Tierney, '87; Andrew Firenze, '87; and Ted Larkin, '88.

Sharra sends news about a bevy of other classmates. She and **Jen Singer** attended John Ko's, '89, wedding. Jen is working in New York City for Goldman Sachs in corporate finance. Sharra also has been in touch with **Amy Thorsen**, who is "really enjoying" medical at New York University; **Jen Uhle**, who is getting a PhD in nuclear engineering from MIT; and **Ellen Chen**, who is in Connecticut. . . . **Brian Katz** is teaching high school science in New Jersey, and **Ed Munnich** is teaching English in Japan. . . . **Alan Beale** works for GE in Wisconsin. . . . **Thomas Cole** sends news that **Felipe Calderon, Laura Pitone**, and he

Newest Classes Boast Most-Honored Athletes

Lisa Arel, '92

Rod Tranum, '93

The Class of 1992 and '93 can claim two of the top athletes ever to have competed for the Institute: gymnast Lisa Arel, '92, and football player Roderick Tranum, '93. And despite the stark differences between their sports, Arel and Tranum have accumulated strikingly similar lists of honors and achievements.

Lisa Arel is the finest women's gymnast in the history of the sport at MIT. She has held the MIT record in every gymnastics event (bars, beam, floor exercise, vault, and all-around), was elected the team's most valuable player four years running, and was twice named first-team GTE Academic All-America by the College Sports Information Directors of America.

Likewise, Rod Tranum is the best wide receiver in the history of MIT football. He holds Institute records for catches in a game, season, and career; yards gained receiving in a season and career; and longest reception. The 1992 MIT team offensive MVP, Tranum was a second-team GTE Academic All-America for 1991, and was the GTE College Division Football Academic All-America of the Year in 1992.

Both Arel and Tranum have won prestigious Postgraduate Scholarships from the National Collegiate Athletic Association (NCAA). Arel is currently applying her award toward medical school at the University of California at San Francisco, while Tranum entered MIT's Leaders for Manufacturing Program in the fall.

Their collegiate athletic careers have both been crowned by national recognition: Arel was one of 10 finalists for the 1992 NCAA Woman of the Year Award sponsored by Champion Athletic Products, while Tranum is one of 15 college football players in the nation to be named a National Football Foundation and College Hall of Fame (NFFHF) Scholar-Athlete for 1992.

Arel and the other honorees were feted at last winter's NCAA Women of the Year banquet in Chicago, which was hosted by the Sara Lee Corp., owner of Champion Athletic Products. John H. Bryan, chair and CEO of Sara Lee, told the gathering that they were selected because they are "great students, great athletes, and you are committed to your community and the people around you." He went on to say that "you are the perfect role models for both your peers and especially for younger women."

The Woman of the Year competition produces a winner from each state, 10 finalists, and one national winner. Sara Lee Corp., the first major corporation to sponsor women's collegiate athletics, awarded $5,000 to each institution that produced a state winner and an additional $5,000 to each institution that had a finalist. The money is specifically earmarked for women's athletics, and MIT has established the "Lisa Arel '92 Fund" in the Department of Athletics.

Tranum was honored at an NFFHF Awards Banquet in New York City, where emcee Chris Schenkle of ABC Television drew oohs and ahs from the crowd when he spoke of Tranum's perfect 5.0 grade point average in electrical engineering. "At the press conference, a reporter asked Rod Tranum why, with the academic demands of a school like MIT, Rod would play football," Schenkle told the banquet audience. "Rod looked at the reporter and answered simply, 'To keep my sanity.'"

Tranum will receive an $18,000 scholarship spread over two years from the NFFHF. His selection as an NFFHF Scholar-Athlete marks the fourth consecutive year that an MIT player has been so honored—a record no other college in the country has been able to match in the 34 years in which the awards have been presented.

—Roger Crosley □

The author is sports information director at MIT.

completed their two-year program with General Electric. All three now live in Schenectady, NY, and work with GE Industrial & Power Systems. "We will be making steam and gas turbines and generators for producing electricity. All three of us are looking forward to being close to Boston." Tom also sends news that a huge photo of **Darcy Prather** appeared in an issue of the *St. Louis Post-Dispatch*. Darcy recently finished his work at Oxford as a Rhodes scholar and will now work in Chicago.

Navy ensign **David Haldeman** received his "Wings of Gold" when he was designated a Naval flight officer after 18 months of flight training. The Navy sends news that David's curriculum included studies in extended navigation flights, air intercept control training, and aircraft familiarzation. . . . I recently spent my birthday weekend in New Hampshire with **Pete Stewart** and his finance, Melissa Schulz, and **Paul Antico**, along with a group of friends from law school. Paul and Melissa both got up on skis for the first time. Pete is a veteran waterskier by now and joined Paul to try their hand at sailboarding. We all swapped ghost stories and s'mores.

I'd love to hear about any of your recent vacations or athletic exploits. Please send news.—**Andrew Strehle**, secretary, 566 Commonwealth Ave., #406, Boston, MA 02215, (617) 262-3495

92

Happy holidays to all—especially to Thompson Jeffrey, son of **Tona Hangen** and her husband Don. Thompson will be 1 year old this December 1st. Tona reports that their son is

AREL PHOTO: JET COMMERCIAL PHOTOGRAPHERS, INC.

quite a handful already. She is working on a PhD in history of American civilization at Brandeis University while Don, an orthopedic surgeon, is doing a post-residency fellowship at Mass General. This past summer, Tona, Don, and Thompson went off to Bhutan via Bangkok, for a month as health volunteers with Orthopedics Overseas.

After graduation, **Luis Gonzalez** worked for a small company in Cambridge that specializes in X-ray equipment (like for airport security). Last January, he started working at Wellesley College as an admissions counselor and as the "systems coordinator." Luis is very happy there. He also reports that **Daniel Olster** was in Japan a few months ago just for vacation.

As I write this, it is approaching **Wyatt Webb**'s fourth wedding anniversary—Congratulations! He and his wife were married between freshman and sophomore year and now are happy to announce that they celebrated their son's first birthday this past July. David Andrew was really little when he was born, as he was 7 weeks early, but now he's 22 lbs. and 30 inches tall. Glad to hear all is well. Wyatt says David just started walking recently and has gotten a bunch of teeth. Wyatt has been working for Tektronix since graduation in the software development group. He says the new release of WaveWriter was scheduled to be out this past August. Wyatt and his family are living happily in Aloha, Ore.

Newton Agrawal writes that he is back in Stillwater, Okla., after a year of traveling across the country. He is working as a researcher in optics during the day and spent his summer evenings sailing and windsurfing. In Oklahoma, you ask? Yes! Newton says that a lot of Californians are actually moving to Oklahoma because of the more affordable living and still having the breezy, sunny weather. A little hard to believe—I thought the lure of Cali was the fact that it's on the coast. Newton has been quite involved in reviving the MIT Alumni/ae Club of Oklahoma, which had been dead for eight years. President and Mrs. Vest actually traveled to OK to participate in the kickoff of the club.

Annie Kerr spent last year working for an architecture firm , took the summer off to travel, and returned to MIT this fall in the dual degree program for an MArch and a masters in city planning. She also made me feel old when she reminded me in her note that it was five! years ago that we went to a George Michael concert together at Madison Square Garden.

Chris Young definitely gets the prize for most news this issue. Don't get too excited, Chris—there is no prize, just my undying gratititude. Chris tells me he got to ski twice last winter and is hoping to make it out to Aspen this winter to visit me and hit the slopes. Yeah—guess which is first priority? Last summer Chris took a screenwriting class at Emerson and took it easy. Then, he found himself a *Three's Company* situation, living with a woman from Smith College and her friend from Denver (also Chris's hometown). They found a place on Prince Street in the North End where he'd never ventured during his days at MIT. Chris finds life confusing these days, as both of his roommates are named Amy and his girlfriend is Amy, too.

After the summer, Chris started an internship at a media production company which specializes in making documentaries about the environment and indigenous cultures of the world. To pay the bills, he worked at the Museum of Science at the traveling *Star Trek* exhibit. Unfortunately, the internship was not all fun and games like the Trekkie job. Chris started at Northwestern University this fall to pursue an MFA in directing, producing, and screenwriting, so all of you aspiring MIT actors and actresses know who to get in touch with now to get famous quick.

Chris has learned a lot about the Boston area this past year. His apartment has great views of the city and a spectacular night view of the Old North Church. There are feasts and festivals every weekend in the summer where the neighborhood marches their patron saints around and enjoy music, food, and fireworks. Chris says "In the last year, I've learned how interesting it can be to walk from Harvard all the way to the North End, I've learned that there are beaches only a couple of T-stops away in South Boston, I've gone camping on an island in the Outer Boston Harbor and have come to realize that riding the T every day is a tremendous entertainment bargain for only a $27 pass.... Now that I've come to relish living in diverse and always interesting Boston, I actually regret having to leave so soon; something I never would have imagined five years ago when I stepped off the plane from Denver. I hope that Chicago can capture my imagination as much as Boston has."

Chris reports more still. He ran into **Jill Soley** who is in the Cambridge area working for Chedd-Angier Productions of Watertown. They specialize in science-oriented work and produce the PBS series *Scientific American Frontiers* with Woodie Flowers, PhD '73. Jill is working on several projects for some big museums across the country. She is happy but is considering returning to school in a year or so. . . . **Dave Chase** is living in Wichita, Kans., and is working for an environmental consulting firm. He was married on August 21 to a woman he met two summers ago through Campus Crusade. He proposed to her in front of her entire Kansas State University sorority during a special ceremony. . . . **Mike Olivas** finished his degree requirements and walked this past June and has since returned to El Paso, since the job market is better there for his field. . . . **Alou Macalou** spent the summer at NASA in California following his first year of grad school at Georgia Tech. . . . **Kevin Scannell**, who graduated a year early, is in his second year at UCLA and has supposedly become engaged to his longtime girlfriend from Wellesley. . . . **Charlie Choi** is living in Ypsilanti, Mich., working for Ford. He gets to road-test the new 1994 Mustang around the country as part of his job. Seems appropriate for one of the winners of the 2.70 contest.

And as Chris Young says, "I hope that your next year is as great as the past one sounded. I also hope that I won't completely lose touch with all the great people I met while at MIT who are destined for great things in the years to come. As secretary, you will provide the only link that most of us will be able to maintain with our friends afar until we are lucky enough to run into each other by some quirk of fate or at the occasional reunion. Keep up the good work."

Those words are for all of you. Thanks for the spirit, Chris, and thanks to all of the wonderful people who wrote to me. Keep it up. It's all about us. '92 alive and well! Write to me: **Leslie A. Barnett**, secretary, P.O. Box 7604, Aspen, CO 81612-7604, or call (303) 920-7769, or fax (303) 925-9389.

93

For all of you who flipped anxiously past all the wonderful articles in October's *Technology Review* hoping to find notes on the Class of 1993 but found only disappointment, I apologize. I hope this issue will meet with approval.

"Married life is great!" says **Roddy Tranum**. He should know, since he married his wife, Sheila, just days after graduation. They now reside in MIT married student housing while Roddy attends MIT's Leaders in Manufacturing program. Other newlyweds include **Steve Ko** and **Sophia Yen**, who are now living in San Francisco. Sophia attends medical school at UCSF while Steve works at Apple. I know there are other class of '93ers who have joined the married ranks. Please write so I can include you in the next issue!

The number of people who "just can't get enough" of MIT is incredible. Finishing up five-year programs for SB/master's degrees are **Dana Burghdoff** in city planning, **Tony Ezzat** in Course VI, **Homero Gutierrez** in aeronautics and astronautics, **Neil Tender** in electrical engineering, and **Andrew Okkson**, also in Course VI. . . . **Amir R. Amir** continues his studies in aeronautics and astronautics on the graduate level, as does **Carolos Livadas** and **Kevin Lee**. . . . **Agnes Ayuso** pursues a masters in environmental engineering. . . . **May Nasreallah** is "doing an MBA at Sloan."

While many choose to further their education at MIT, others have spread their wings to study elsewhere. **Lori Yerkey** is in California, and studies for a PhD in organic chemistry at CalTech. . . . Also in California is **Emily Yeh**, who pursues a Berkeley PhD in electrical engineering. Emily may run into **Kristine Ma** or **Yeh-Kai Tung**, who attend Berkeley as well. There, Yeh-Kai Tung is going for a PhD in physics. . . . Elsewhere in California, **Jong Lee** and **Jacob Bernstein** work towards SM degrees at Stanford University. . . . Back on the East Coast, in New York, **David Winter** is at Columbia University for a PhD in physics, while **Michelle Caruso** is at the same place for an MD. . . . Closer to MIT, **Christine Goddard** can be found in the Chemistry Department at Harvard studying for a PhD, not far from **Kelly Sullivan** attending medical school.

But what about the graduates who joined the workforce? Here they are. MIT is known internationally for the excellent caliber of its graduates. . . . Representing us in Japan are **Lisa Chow** and **Cyrus Shaoul**. Cyrus works at an R&D lab in Yokosuka. . . . In Sweiname, South America, **Kathleen Lieuw Kie Song** works as the commercial/economic specialist for the U.S. Embassy. . . . Working for Union Bank Switzerland is **Brian Dunkle**. he will be "part of a programming team intended to bring their database system into the 21st century." . . . Finally, **Peta** and **Paula Lewin** are traveling the world. No doubt that all these people, and others who are unmentioned, are supporting MIT's reputation.

On the homefront, **Julie Stein** and **Jennifer McMurray** are working in Alberquerque, N.M. Julie works for Intel as a process engineer. . . . **Ivana Markovic** started working for Michelin as a chemical process engineer. "It is a really great company," she writes. . . . **Monica Dodds** spent time with her family in San Diego before road-tripping to Sacramento, where she now works for Procter and Gamble Manufacturing.

We want to know what you're up to! If you'd like to see your name in print and your friends' names too, please write.—**Mari Madsen**, secretary, 14-16 Ellery St., #405, Cambridge, MA 02138

COURSE NEWS

I CIVIL AND ENVIRONMENTAL ENGINEERING

Mishac K. Yegian, PhD '76, chair of the Department of Civil Engineering at Northeastern University, has been given the Armenian Students Association Kabakjian Science Award. The award was established in 1948 to honor an American of Armenian descent who has made contributions in a field of science, and to encourage young Armenian students to pursue a career in science or engineering. Yegian has made many contributions to the science of earthquake engineering. He has conducted in-depth research on the dynamic responses of earthquake ground motions and site analysis on projects throughout the world, including the United States, Armenia, Iran, Turkey, and Japan. . . . **Kathryn Donna June Ayan**, SM '85, has received an MBA from the Darden School at the University of Virginia. Ayan was the recipient of a Faculty Award for Academic Excellence upon graduation. She will assume a position as project development manager with Duke Energy Corp., in Charlotte, N.C. . . . **Paul Mathisen**, SM '89, PhD '93, joined the faculty at the Worcester Polytechnic Institute this past summer.

The Association of Alumni and Alumnae has been notified that Colonel **John B. Rippere, Jr.**, SM '39, of Long Beach, Calif., died on October 26, 1992. No further information was provided.

II MECHANICAL ENGINEERING

Joseph K. Ting, SM '74, writes : "At the ASHRAE (American Society of Heating, Refrigerating, and Air-conditioning Engineers) 1993 Annual Meeting in Denver, I was appointed as chair of the Refrigeration Committee, one of the five grassroot committees of the society. I also serve as assistant regional chair for ASHRAE Region I, which covers 15 chapters in the Northeast including six New England States, New York State and Northern New Jersey. Currently, I am serving my second term as president of the MIT Alumni/ae Club in the Capital District of New York. In between the above activities, I try to find time to serve as president of the Chinese American Community Center." . . . **Paul Cooper**, SM '59, director of advanced technology at Ingersoll-Dresser Pump Co. in Phillipsburg, N.J., received the ASME Henry R. Worthington Award at the Society's International Conference on Fluids Engineering in June. Cooper was given the award for "his leadership in the centrifugal pump industy, worldwide." The medal, established in 1980, is bestowed for eminent achievement in the field of pumping machinery. According to an ASME news release, "Cooper began his career in 1959 for Ingersoll-Rand as a specialist in the fluid-dynamic design of aircraft fuel pumps. His hydraulic designs were used in more than a dozen commercial and military aircraft types. During this time he was also involved in government-sponsored pump research, simulating two-phase flow inducer performance, including the thermodynamic effects of cavitation, and developing turbulence models that successfully predicted impeller disc friction. In 1977 he was promoted to staff researcher on flow and cavitation in commercial pumps at Ingersoll-Rand's Research Center in Princeton, instituting design improvements that have reduced cavitation damage and extended the life of pipeline and boiler feed pumps. Cooper also established guidelines for optimizing the hydraulic design of high-speed pumps, slurry pumps, multistage power recovery turbines, and low-head hydroturbines." . . . **Erwin G. Loewen**, SM '49, ME '50, ScD '52, has been awarded the 1993 Fraunhofer Medal of the Optical Society of America. The award cites "fundamental technical contributions and teaching which has furthered the application of the principles of precision optical engineering, particularly with regard to the theory, design, and manufacture of diffraction grating structures." In addition to his assignment as VP emeritus for R&D of Milton Roy Co., a division of Sundstrand Corp., he is a part-time professor of optics at the Institute of Optics of the University of Rochester.

III MATERIALS SCIENCE AND ENGINEERING

From State College, Pa., **Long-Qing Chen**, PhD '90, writes: "After graduation I spent two years at Rutgers University as a postdoctoral fellow and joined the ceramics faculty at Penn State in the summer of 1992." . . . **Eva Csizinszky**, SM '92 (XV), SM '92, has been appointed superintendent of manufacturing at the Delco Chassis Division of General Motors Corp. in Kettering, Ohio. Csizinszky is in charge of power boosters for brakes, as such she is the woman in the highest level of management at this plant. The facility has a total of 1,500 employees, one-third of whom fall under her responsibility. . . . Lehigh University recently honored two MIT alums for 25 years of dedicated service on its faculty: **Joseph I. Goldstein**, '60, SM '62, ScD '64, the R.D. Stout Professor of Materials Science and Engineering, and **David A. Thomas**, ScD '58, professor of materials science and engineering. Goldstein specializes in electron microscopy and its application to meteorites and diffusion controlled transformations. As a principal investigator in NASA's Lunar Sample Program, he performed research from 1969 to 1980 on returned lunar samples from Apollo flights. Thomas specializes in the structure, processing, and mechanical behavior of materials. He holds three patents for strengthening of ceramics and for interpenetrating polymer networks.

David Higbee

David A. Higbee, SM '65, has been appointed VP for diversified businesses at Armco in Parsippany, N.J. In his newly created position, Higbee will have operating responsibility for several of Armco's businesses, including Armco do Brazil S.A., Worldwide Grinding Systems, Douglas Dynamics, Cytemp Specialty Steels, Flour City Architectural Metals, and Armco Stainless and Alloy Products. Higbee joins the company after serving as president and CEO of National-Oilwell, a Houston-based oil field machinery and equipment manufacturer that is owned by Armco and USX Corp.

IV ARCHITECTURE

Martha E. Ondras, MAR '74, writes: "I am heading a 25-person architectural firm, Ondras Associates, in Cambridge, which I founded 13 years ago. We are working on several Central Artery/Tunnel buildings and Logan Airport projects, as well as housing, university, and laboratory projects. I am also raising a son and a daughter and coaching soccer."

DEGREE CODES

AE	Aeronautical Engineer
BE	Building Engineer
CE	Civil Engineer
CHE	Chemical Engineer
CSE	Computer Science Engineer
DPH	Doctor of Public Health
EAA	Aeronautical & Astronautical Engineer
EE	Electrical Engineer
EGD	Doctor of Engineering
ENE	Environmental Engineer
MAA	Master in Architecture Advanced Studies
MAE	Materials Engineer
MAR	Master in Architecture
MCP	Master in City Planning
ME	Mechanical Engineer
MET	Meteorologist
MIE	Mineral Engineer
MME	Marine Mechanical Engineer
MNG	Master in Engineering
MPH	Master in Public Health
MTE	Metallurgical Engineer
NA	Naval Architect
NE	Naval Engineer
NUE	Nuclear Engineer
OCE	Ocean Engineer
PhD	Doctor in Philosophy
ScD	Doctor of Science
SE	Sanitary Engineer
SM	Master of Science

Theodore Mariana

Theodore F. Mariani, SM '57, has been selected to receive The American Institute of Architects' (AIA) 1993 Edward C. Kemper Award. Named in honor of the AIA's first executive director, the Kemper Award recognizes significant contributions to the institute and the profession of architecture. Mariani has served the AIA over the years and his posts have included national VP in 1984, chair of the institute's Legal Oversight Committee from 1984–90, and Middle Atlantic region representative on the AIA board of directors from 1981–83. As an architect, consulting engineer, and professional planner, Mariani has practiced in the nation's capital since 1957. His award-winning 20-person firm, Mariani Architects-Engineers, P.C., specializes in large-scale institutional projects, including the Georgetown University Medical Center, the University of the District of Columbia's Van Ness and Mount Vernon Square campuses, the Catholic University of America master plan, and the National Rehabilitation Hospital. . . . **William L. Rawn III**, MAR '79, president of William Rawn Associates, Architects, Inc., sent us a reprint of a *Washington Post* article in which his firm is credited with receiving the 1993 Urban Design Excellence Award from the American Institute of Architects for The Back of the Hill Rowhouses, 165 units of affordable town house units in Boston's South End. . . . **Paul Lukez**, MAR '85, writes: "Last March, my firm, Paul Lukez Architecture & Design, submitted a portfolio to *Progressive Architecture* for the Young Architects Competition. We included a range of theoretical and built projects that my studio has been engaged in since its inception two years ago. We were pleased to hear that we were selected to be featured in the 'Young Architects' issue of *PA* this past July. We also received an award from the American Society of Perspectivists for a rendering of a research project 'Traces of the Artery.' This same project was featured in an ACSA traveling exhibition of faculty work for 1992–93. We have also been fortunate to have some of our residential projects published locally in the *Boston Globe* and other regional papers. Last May, we appeared in the German journal *Der Architect* and last summer an article discussing our research efforts in representing space was featured in *Places*. And finally, a new Boston-based journal, *Theory and Praxis*, will be publishing an article about the Rolling Bridge Initiative. Despite starting the firm in the midst of a severe Northeastern recesion, we feel very fortunate to have weathered difficult economic conditions without sacrificing the quality of our professional endeavors. Our office is currently designing and supervising construction on residential and commercial projects in New England." . . . *Objects in Action: Commercial Applications of Object-Oriented Technologies* (Addison-Wesley, 1993) is a new book by **David A. Taylor**, '70, and Paul Harmon. According to the book jacket, "Software developers and managers intrigued with the potential of object-oriented technology will find [the book] an exciting eye-opener. The 19 real-life applications showcased in this book prove unequivocally that object-oriented technology has finally moved from the realm of the theoretical to the world of full-scale, working application." Taylor is the author of the best-selling *Object Oriented Technology: A Manager's Guide* (Addison-Wesley) and *Object-Oriented Information Systems: Planning and Implementation* (Wiley). He served as a judge in the 1992 Object World contest and, in writing *Objects in Action*, worked closely with the originators of the case studies.

Rai Y. Okamoto, MAR '51, of San Francisco, Calif., died on July 7, 1993. Okamoto was an architect and urban designer who was director of city planning in San Francisco from 1976–81. He worked in New York, Seattle, and other cities advocating mixed-use development and improved public transit to create lively and humane cityscapes. His main contributions were in downtown Oakland, where he helped to plan the Civic Center project, and the Yerba Buena Center redevelopment project in San Francisco where he headed the design advisory panel from 1981–90. Okamoto taught at MIT, the Danish Royal Academy in Copenhagen, Cornell, Princeton, and University of California at Berkeley. In 1961,while at UC/Berkeley, Okamoto established the firm of Okamoto Associates, which over time would come to be known as Okamoto, Murata & Mittelstadt. He was the author of *Buildings of the Bay Area* with John and Sally Woodbridge in 1959, and *Urban Design Manhattan*, a set of large-scale proposals for midtown, in 1969. He was awarded Fullbright, Guggenheim, and National Endowment for the Arts fellowships.

V CHEMISTRY

Jeffrey A. Gray, PhD '88, has been appointed assistant professor of chemistry at Ohio Northern University in Ada, Ohio. Gray has been a senior member of the technical staff of the combustion research facility at Santa National Laboratories in Livermore, Calif., since 1987. He has taught at MIT and Penn State and has written several articles. . . . **George M. Milne, Jr.**, PhD '69, has been named president of central research at Pfizer, Inc., in Groton, Conn. Prior to this promotion, he was senior VP. . . . **Ron Brisbois**, PhD '90, assistant professor of chemistry at Hamline University in Saint Paul, Minn., has received a $500,000 Presidential Faculty Fellow Award (PFF) for his work in organic chemistry. PFF awards are intended to allow recipients to undertake self-designed innovative teaching projects, to establish research and teaching programs, and to pursue other academically related activities. . . . **Eric Stoner**, PhD '91, was honored by the the University of Wisconsin Center-Rock County during its annual honors ceremony last May. Stoner earned his bachelor's degree from UW-Madison in 1986 and is now employed by Abbott Laboratories in process research and development chemistry. He served as a lecturer at MIT.

Herbert H. Uhlig, PhD '32, of Hancock, N.H., died on July 3. Uhlig was a professor emeritus of metallurgy at MIT and a pioneer in the study of metal corrosion. He was a research chemist at the Rockefeller Institute for Medical Research in New York City and, later, assistant chemist at Lever Brothers in Cambridge. He became a research associate at MIT in 1940, but when funds became scarce during WWII, he transferred his investigations of corrosion to the General Electric Research Laboratory in Schenectady, N.Y. He returned to MIT in 1946 as associate professor and director of the corrosion laboratory. In 1953 he was promoted to full professor. He continued his teaching and research until his retirement from MIT in 1972. In 1982, the corrosion laboratory was dedicated in his honor and renamed the H.H. Uhlig Corrosion Laboratory. After his retirement he continued to do research and teach part-time at MIT. . . . **Franklin K. Pittman**, PhD '41, of Oklahoma City, Okla., died on June 27, 1993. He was an instructor of chemistry at MIT from 1940–43 and a research chemist for Cohart Refractories from 1943-44. From 1944–48, he worked on the Manhattan Project for Los Alamos with various responsibilities in the processing, recovery, and fabrication of plutonium for the Atomic Bomb Project, culminating in the position of manager of the Plutonium Production Site from 1946–48. Upon leaving he worked until 1964 with the Atomic Energy Commission, serving in key positions in several divisions. In 1967 he moved to Oklahoma City to become director of technical services in the Nuclear Division of Kerr-McGee Corp. In 1971 he became director of the division of waste management and transportation in the Atomic Energy Commission, which was renamed the ERDA in 1975. Pittman retired from the government in 1975 and was self-employed until 1984 as a nuclear consultant. He belonged to many societies and organizations including Tau Beta Pi, and among the many medals he received was the Federal Career Service Award in 1960.

Robert W. Davison, PhD '50, of Wilmington, Del., died on June 25. He was a physical chemist at Hercules Research Center, from 1950 until his retirement in 1990. He did research in paper chemicals and was elected a TAPPI (Technical Association of Pulp and Paper Industry) Fellow in 1989. Davison's professional career is well described in a recent TAPPI book to which he was a contributing author: "Davison is in large part responsible for the industry's current understanding of the structures and properties of fibrous layered products such as paper and non-woven fabrics. His research into the mechanisim of rosin sizing led to his developing the highly efficient fortified dispersed rosin sizes for which he received a patent in 1971. His mechanistic picture of internal sizing provides the industry with an understanding of all types of internal size chemistries. Davison is the author of numerous publications and holds six U.S. patents and four international patents." He was a member of the American Chemical Society and of Sigma XI. During WWII, he served in the Navy from 1943–46, where he was a radio officer in the Pacific. . . . **Michael A. DeSesa**, PhD '53, of Brookline, Mass., died on June 30. He was VP for research at Rheox, Inc. DeSesa was an authority in the fields of rheology (the science of the deformation and flow of matter, such as blood through the heart and arteries) and anti-corrosive pigments. He was a member of the American Chemical Society and the Society for Applied Spectroscopy. He was also president of the Association of Research Directors.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

From Virgina Beach, Va., **Ralph T. Soule**, SM '91 (XXII), SM '91, writes: "I am the equivalent of a plant engineer for one of the USS *Enterprise*'s four propulsion plants, each includes two nuclear reactors, propulsion turbines, steam turbine generators, and support equipment. The *Enterprise* refueling and overhaul is the most complicated and technically challenging job of its kind ever undertaken by the Navy." . . . **Katsumi Yamane**, SM '71, reports: "After being an electrical engineer at Hitachi, Ltd., in Japan, I

became a physician in 1983, and founded Yamane Clinic of Internal Medicine in 1987." . . . **Rudolph A. Schlais, Jr.**, SM '65, has been appointed general manager of the General Motors Corp.'s Packard Electric Division in Youngstown, Ohio. Prior to this Schlais was in Sandusky, Ohio, as general manager of the GM's New Departure Hyatt Division.

Jerry Prince

Jerry L. Prince, SM '82, EE '86, PhD '88, an assistant professor in the Johns Hopkins University School of Engineering, has won a 1993 Presidential Faculty Fellow Award from the NSF. The award consists of a grant of $100,000 a year for five years. The awards are designed to support the research and teaching activities of outstanding young science and engineering faculty early in their careers. Prince holds a joint appointment in the Department of Radiology at the Johns Hopkins Medical Institutions and also collaborates with researchers at the Applied Physics Laboratory and the School of Engineering for Nondestructive Evaluation. His ongoing research includes the development of a computerized system using magnetic resonance imaging for measuring cardiac motion. The system produces three-dimensional "movies" of a beating heart that enable cardiologists for the first time to see by non-invasive means that motion of a human heart through its entire beat cycle. With further development, this technology could permit physicians to identify diseased heart and muscle long before it can be diagnosed by other techniques. Prince will use his grant to continue studies of fundamental problems in motion estimation and geometric reconstruction in three dimensions. The former—estimating the displacement of objects as they move within an image sequence—is a central problem in image processing and computer vision. . . . **Walter J. Gajda, Jr.**, SM '65, PhD '70, chair of electrical engineering at the University of Missouri-Rolla, has been named vice chancellor for academic affairs for the university. Gajda, who is also a Rutledge-Emerson Electric Distinguished Professor of electrical engineering, began his new duties last July. He joined the UMR faculty in 1986 and before that served on the faculty at the University of Notre Dame.

David W. Tong, SM '71, EE '72, PhD '75, of Scotia, N.Y., died on June 5. Tong joined the General Electric Co. in 1976. He was a member of the International Electric and Electronic Engineers and the GE Elfun Society. . . . **Albert C. Hall**, SM '38, ScD '43, died on September 14, 1992. He served as assistant secretary of Defense (Intelligence) from 1971 to 1976, and was the first individual to hold that office. He was responsible for organizing that office and managing, in behalf of the secretary, all intelligence programs in the Department of Defense. He served as the principal liaison with the director of Central Intelligence and as the Defense member of the White House coordinating group for intelligence. Hall had been with Martin Marietta Corp. since 1958 except for a two-year assignment from 1963–65, with the Office of the Secretary of Defense, where he was deputy director of Defense Research and Engineering for Space. Hall's first assignment at Martin Marietta Corp. was director of engineering for the Denver Division where he was responsible for the engineering on the Titan I and the design of the Titan II. As VP and general manager of the Space Systems Division from 1962–63, Hall was responsible for organizing the company's effort on the development and production of the Gemini Launch vehicle. In 1965, Hall rejoined the corporation and served in the post of VP for engineering until his appointment to the Department of Defense in 1971. During WWII, as a member of the MIT faculty, he led the development of the control system for the U.S. Navy's first operational guided missile. Following WWII, at the request of the Navy, Hall founded and was director of the Dynamic Analysis and Control Laboratory at MIT from 1945 until 1950. That laboratory developed advanced high performance hydraulic control systems, an electronic analog computer with sufficient capacity to simulate missile dynamics, plus an air-to-air real time missile simulator which incorported a three-dimensional flight table. Hall was a member of many organizations including the National Academy of Engineering and he twice received the Distinguished Civilian Service Medal, among many others.

VI-A INTERNSHIP PROGRAM

A number of changes in the Department's administration will be of interest to readers. Particularly relating to VI-A is the expected retirement of Director **Kevin J. O'Toole**, SM '57, NE '57 (XIII), on the first of September (I am writing in mid-August). Kevin will complete 20 years of association with MIT, having joined the Department of Ocean Engineering as a professor in 1973 while in the U.S. Navy. He joined Course VI in August 1985 as associate director of the VI-A Internship Program and became director two years later. He has guided the Program through a period of difficult times for American industry and leaves the Program in a strong, well-organized position. We wish him much happiness in his retirement and thank him for his years at the helm of VI-A. As of this writing his replacement has not been selected.

Effective September 1, Associate Department Head for Computer Science and Engineering Professor **Fernando J. Corbató**, PhD '56 (VIII), will step aside and return to teaching and research under a Ford Professorship appointment. Replacing him will be **John V. Guttag.** There are also several changes in the Department's Graduate Office coincident with the June 3 retirement of Professor **Campbell L. Searle**, SM '51, whom many of you knew when you entered the graduate phase of VI-A. Professor **Frederick R. Morgenthaler**, '55, SM '56, PhD '60, is taking over as graduate officer and he'll be assisted by Professor **Alvin W. Drake**, '57, SM '58, EE '61, ScD '62, who will become graduate registration officer.

Incidentally, I have had my half-time appointment continued for another year and will be able to act as a consultant to whomever becomes the new VI-A director and to continue with this column for *Technology Review*.

At a gathering in May I talked with Professor **Carey M. Rappaport**, '80 (XVIII), '82, SM '82, EE '82, PhD '87, of Northeastern University who informed me he has received a tenure appointment in their Department of Electrical & Computer Engineering. He's also a technical associate director for their Center for Electromagnetics Research. Carey's wife, Ann, is Professor Morgenthaler's daughter. Congratulations on all counts!

Contact with alums is one of the pleasures of my continued association with MIT, even though I'm technically retired. An e-mail from

Jeffrey P. Applebaum, '89, SM '90, brings greetings from Sunnyvale, Calif., where Jeff is working for Cadence Design Systems.

Geoffrey J. Bunza, '74, SM '77, EE '78, PhD '81, and family vacationed in Falmouth, Mass., on Cape Cod this July, and invited me down for a day's visit. My sister and family live nearby, so I managed a double visit. Geoff and I being railroad buffs, we decided to ride the Cape Cod RR's Dinner Train out of Hyannis one evening, and had a delightful scenic trip to Sandwich and along Cape Cod Canal while enjoying a delicious meal in a well-appointed, air-conditioned dining car. Geoff is now a partner in a new venture called Technologies & Transitions located in Tigard, Ore. He still lives in Beaverton, Ore.

Lester A. Gimpelson, '57, SM '59, EE '61, called from his home in Belgium where he's now retired from ITT. He desired some background information for work he is doing to revitalize a local MIT Alumni/ae Club. Provost Mark S. Wrighton was attending a conference in Belgium, and was to meet with Lester and a group as part of his trip.

Having been in my MIT job for lo these many years (37), it is interesting when the beginning and the present come together. For example, one of my advisees, **Richard S. Grinnell**, '93, SM '93, joined PictureTel, north of Boston, upon graduation this past June. He keeps in touch and recently told me his work takes him to Bell Labs in New Jersey, where he's being brought up to date in the latest transmission standards. Well, it seems his mentor there is **Marshall G. Schachtman**, '57, SM '58, who is now in a consulting arrangement following his retirement from Bell Labs. Marshall was here for VI-A's 75th Anniversary Celebration last June, and we had a great reunion. Coincidentally, Lester Gimpelson and Marshall were classmates and among my first student acquaintances when I came to MIT (February, 1956).

A summer office visitor of long acquaintance was **Joel E. Schindall**, '63, SM '64, PhD '67, with his wife and two daughters. Joel is president of Loral Data Systems-Conic in San Diego, Calif. He was previously with Watkins-Johnson Co. in Palo Alto, and I'd see him during my summer visits to Hewlett Packard Co. as VI-A director, when I ran the VI-A picnics in conjunction with the MIT Club of Northern California.

It's a wonderful window on life keeping in touch with so many of you alums whom I first knew as students and who are now making a mark out in the world at large. Please continue the contacts!—John A. Tucker, director (emeritus), VI-A lecturer., MIT, Room 38-473, Cambridge, MA 02139-4307.

VII BIOLOGY

Richard C. Mulligan, '76, Course VII professor and member of the White Institute for Biomedical Research, has been named the first recipient of the American Society for Biochemistry and Molecular Biology (ASBMB) Award. The new award, established by Amgen, Inc., recognizes achievement in using biochemistry and molecular biology to understand disease. Mulligan, a leader in discovering new technology for the transfer of genes into mammals' cells, has created viruses that carry foreign DNA into other cells. Scientists use this technique in gene therapy, cancer research, and lab experiments when dealing with questions about human development. The award consists of a $5,000 prize for Mulligan along with a $20,000 research grant for Mulligan's lab.

The Association of Alumni and Alumnae has been notified that **Jeanette H. Levens**, MPH '42, of Marina del Rey, Calif., died on May 25. No further information was provided.

VIII PHYSICS

The Association of Alumni and Alumnae has been notified that **Camille B. Draskoczy**, '62, of Weston, Mass., died on November 4, 1992. . . . **Harold Emil Rorschach, Jr.**, '49, SM '50, PhD '52, professor and chair of the Physics Department at Rice University in Houston, Tex., died on June 23. His career at Rice, according to a university news release, was characterized by a dual commitment to teaching and research. Through the years, more than 5,000 science and engineering students enrolled in Rorschach's introductory physics courses. He also guided the research of many PhD graduate students. His research and publications in experimental low-temperature physics and biophysics, the latter in collaboration with Baylor Medical School students, are recognized internationally.

X CHEMICAL ENGINEERING

Miguel R. Unson, SM '42, writes from Manila: "I retired from San Miguel Corp. after 45 years (as executive VP in last position). I am now chair of the National Quality Campaign (promoting Total Quality Management in the Philippines). I am also chair of the Centre for Consultants. . . . **Harvey G. Stenger**, ScD '84, professor of chemical engineering at Lehigh University in Bethlehem, Pa., has been appointed dean for research and graduate studies in the College of Engineering and Applied Science. Stenger specializes in reaction engineering, materials processing, environmental concerns, and emission control. He joined the Lehigh faculty as an assistant professor of chemical engineering in 1984 and was promoted to associate professor in 1988. He served as co-chair of the department from 1989–91, and was appointed the director of Lehigh's Environmental Studies Center in 1991. . . . **Allen F. Horn**, PhD '84, and **Graham A. Woerner**, SM '76, were members of a Rogers Corp. development team that created Isocore Coaxial Cable, which recently received second place in the "1993 Plunkett Awards for Innovation with Teflon." The award is sponsored by E.I. DuPont de Nemours, Inc. Rogers used the Teflon material, which is a fluoropolymer resin, to make a composite material for high frequency (microwave) electronic applications. The Rogers material is currently used as insulation in specialized coaxial cables. Horn is a research engineer in Rogers' Danielson, Conn. office and Woerner is now with DeWal Industries in Saunderstown, R.I.

Harvey Stenger, Jr.

Anthony Standen, SM '29, of South Kent, Conn., died on June 22, 1993. To other chemists, Standen was familiar as the executive editor of the 22-volume second edition of the Kirk-Othmer *Encyclopedia of Chemical Technology* (John Wiley & Sons). This work went on for more than 20 years until he retired in 1971. But he was best known as the author of *Science Is a Sacred Cow* (Dutton, 1950), which was in print as a paperback for 40 years. When it first appeared, it drew praise from none other than Albert Einstein, and most reviews applauded as well. Standen's point was that scientists, and especially teachers of science, tended to have inflated egos, certain of their superior wisdom and virtue. In reality, he asserted, they are mostly dull and pompous and should be laughed at now and then. Unfortunately in his view, the general public stood in awe of them even when they talked Latinized nonsense. He also wrote *Insect Invaders* (Hougton Mifflin, 1943), which reviewers called a handbook for insect haters.

X-A PRACTICE SCHOOL

The two Course X winners of 1992–93 prizes from the MIT Japan Program were X-A alumni. **Angelo Kandas,**, SM '93, who won a prestigious Ayakawa Fellowship, will spend the summer of 1994 at the Hitachi Research Laboratory outside Tokyo; he's a third-year graduate student working with Professor **Adel Sarofim**, SM '57, ScD '62. **Roy Kamimura**, SM '92, will use his travel prize next summer to work at Osaka University assessing the status of biotechnology in Japan.

For news of recent graduates and the department, the eyes and ears of X-A are Carol Phillips of the X-A office [66-309, (617) 253-6600, fax (617) 253-8723, e-mail carol@pracschool.mit.edu]. "It's a boy!" wrote **Xinjin Zhao**, SM '90, ScD '93, from Columbia, Md. (zhao@wrc.wrgrace.com), to Carol's e-mail address last July 23. Young Daniel weighed 6 lbs. 8 oz. at birth on July 17. "Baby and mother doing great," wrote Zhao. "Practice School has been the best part of my memory of MIT life. I hope we can have a station at W.R. Grace some day." . . . In Boston for a friend's wedding, **Karen Lee**, '93, reported to Carol on some of SCEP's Minneapolis/St. Paul colony: **Victor Barocas**, '88, SM '89, is working on a PhD at the University of Minnesota; he was assistant director at the Midland Station from 1989–91. **Gina Buccelleto**, '86, SM '86, is working at 3M in St. Paul. And Lee herself works on the development of refrigerated dough products as a process engineer for Pillsbury/Grand Metropolitan Co., Minneapolis; she finished her PhD in chemical engineering at Minnesota in August 1992. . . . Also in Minnesota: **Christine Gundal**, '90, SM '91, product development engineer at 3M, St. Paul, who is now Ms. **Raymond (Mick) Swaka**, SM '91. Mick is also a product development engineer at 3M, and they live in Woodbury, Minn.

After quitting his job at Exxon last spring, **Donald Yee**, SM '91, wrote SCEP that he planned to spend a month in China and this fall to enter the Baylor University Medical School. . . . **Erin Malley**, SM '92, and **Mark Johnson**, SM '92, were married last May; both are working for MIT doctorates in Course X. . . . Last month we told you about the marriage of **Colleen Kelly**, SM '93, but we didn't tell you that the proud groom was Mark Vandevoorde, '87, SM '87 (VI), research associate in computer science at MIT.

From **Michael Abadi**, SM '78, in Boca Raton, Fla.: "I've been working with Ivax Industries, Inc., (the specialty chemicals division of Ivax Corp.) since September 1992. My position is business development manager, and among my responsibilities is the evaluation of mergers and acquisitions for the company." . . . Thanks to **William Katz**, SM '40, for ordering a copy of *The Flagship* and including in his letter a long recollection of his SCEP days in Bangor, Buf-

falo, and Parvin. Especially Buffalo was memorable "for visits to the Iroquois Brewery every Saturday, Lovejoy's restaurant, and ... for getting out from under an open hearth furnace just an hour before the bottom dropped out." Katz, who lives in Glenview, Ill., is retired from an environmental business he founded in 1964 but keeps busy teaching environmental science at Oakton Community College and Roosevelt University, writing environmental audits for Illinois property transfers, and writing a book tentatively entitled *The Environment for Everyone*. He's recently become an accredited asbestos project designer and building inspector. According to Katz, **Jay Mehta**, SM '39, has retired from his job as CEO of Indian Petrochemicals Ltd. in Baroda, India; he's a frequent traveller to the U.S. to visit his son, a member of the University of Florida faculty.

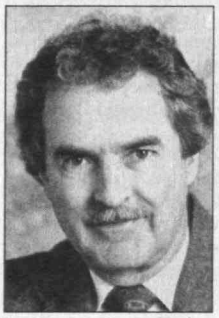
From the *Yale Alumni Magazine* we learn of the death last December 2 of **Donald C. Harrison**, SM '31, who studied law at Fordham (1934) after finishing at MIT. Harrison retired as general counsel for Union Carbide in 1969 and since then had been busy in community affairs in and near Roxbury, Conn., where he and Mrs. Harrison lived: president of the Washington (Conn.) Art Association, vice-chairman of the Northwest Connecticut Regional Planning Agency, and a member of the Roxbury Planning Commission. Harrison died "as peacefully as he had lived," wrote Mrs. Harrison to the Yale magazine. . . . A query for the new Alumni Register brought MIT belated word of the death in July 1990 of **Franklin C. Johnson**, SM '38, in Chestertown, Md.; no further information was available.—Send news to Carol Phillips at SCEP (see above) or John Mattill, *Technology Review*, MIT, Room W59-200, Cambridge, MA 02139.

XI URBAN STUDIES AND PLANNING

R. Steven Konkel, PhD '91, writes: "Since completing a doctorate I have worked as a consultant on Superfund Reauthorization. Currently, I am employed as a senior environmental research scientist at Battelle's Pacific Northwest Laboratory in Richland, Wash. I have made significant contributions to strategic and program plans of three Department of Energy headquarters offices: assistant secretary for environment, safety, & health; assistant secretary for energy efficiency and renewable energy; and office of oversight and self-assessment, assistant secretary for environmental restoration and waste management." . . . **Oscar Fernandez-Taranco**, MCP '82, sends word from Buenos Aires, Argentina: "I work in the United Nations as a senior programme manager in the United Nations Capital Development Fund. We grant investments in social and economic infrastructures (schools, clinics, roads, water supply, irrigation, etc.) and credit programs are undertaken in least developed countries, primarily in Africa. I identify and submit for approval investment packages for Mauritania, Mali, Chad, Madagascar, Tanzanya, and Mozambique. An over 100 million U.S. dollar portfolio is managed from New York."

XII EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

Fred Barker, '50, has received the Meritorious Service Award, the second highest honor given by the Department of the Interior, for significant contributions to the earth sciences and to management and administration of the scientific programs of the U.S. Geological Survey. Barker, a geologist, was cited for "his outstanding contributions as a world-renowned expert on the formation of igneous rocks and their importance to understanding the origin of the continental crust. During his almost 40 years of service, Barker has written and produced over 100 scientific publications." He is a member of the American Geophysical Union and the Geological Society of America.



Robert Copeland

Bob Copeland, SM '57, has retired from his job as a meteorologist at WCVB-TV in Boston, where he has been since it first went on the air in March 1972. Copeland forecasted weather for *Eye Opener* from 5:30-7 am, and *Midday* from noon-12:30 pm each weekday. He has been forecasting New England weather for more than 30 years. From 1966–72, he was the chief meteorologist for the former WHDH-TV. From 1957–66, he worked as a meteorologist for WBZ-TV in Boston. Also, Copeland owns Minuteman Weather Service, Inc., which provides forecasting services to Boston's WEEI Newsradio and several other New England radio stations and publishes the *New England Weather Calendar*. A member of the American Meteorological Society (AMS), he was the 20th meterologist in the United States to be awarded the AMS Seal of Approval. Copeland is planning on pursuing his love of painting during his retirement.

Professor **Robert R. Schrock** of Lexington, Mass., died on June 22. Schrock was a specialist in paleontology, sedimentology, and stratigraphy. He was the author of *Index to Fossils of North America*, *Sequence in Layered Rocks*, and *Principles in Invertebrate Paleontology*. In the course of research trips to various part of the United States, Mexico, Canada, and South America, he discovered several species of fossils and had new species of fossils named after him. Shrock was a member of the University of Wisconsin faculty prior to joining the faculty at MIT, where he taught from 1937 until his retirement in 1975. From 1949–65 he was chair of the Department of Geology and Geophysics. He was a corporation member, trustee, and executive committee member of the Woods Hole Oceanographic Institution, which named a reseach ship after him. The endowed Robert R. Shrock professorship in the Earth, Atmospheric, and Planetary Sciences at MIT is named in his honor. After retiring from MIT he wrote two books on the history of geology: *The Geologists Crosby of Boston* and the two-volume *Geology at MIT: 1865–1965*. At 85, he completed the biography *Cecil and Ida Green: Philanthropists Extraordinary*.

XIII OCEAN ENGINEERING

David A. Higbee, SM '65, has been appointed VP for diversified businesses at Armco, Inc., in Parsippany, N.J. He was president and CEO at National-Oilwell in Houston prior to this move. . . . Navy Lieutenant Commander **Richard D. Lantz**, SM '89 (XXII), NE '89, recently reported for duty at Naval Submarine Support Facility New London in Groton, Conn.

Richard H. Salter, SM '80, was recently profiled in the *Woburn Advocate*, a Woburn, Mass. newspaper. Salter is the owner and administrator of Salter Healthcare Services in Woburn and Winchester, three nursing home facilities. Salter left his position as director of Marine engineering applications at ComputerVision in 1984 to continue in his father's footsteps: taking care of people instead of machines. In the article he discusses positive changes in the nursing care industry. He states that "there is a trend toward short-term advanced therapy for an acute event, such as a broken hip. More and more people go back to the community after a stay of between 30 and 90 days. They 'graduate' and go back home." He is glad he chose the nursing home profession after trying one in engineering. But the latter has had its influence—Slater has written a customized computer program for nursing home management. Another achievement is the patient care quality assurance program entitled "Search for Excellence."

The Association of Alumni and Alumnae has been notified that Captain **Alexander C. Veasey**, SM '36, of Los Gatos, Calif., died on October 18, 1989. No further information was provided.

XIV ECONOMICS

Economic Policy and Household Welfare during Crisis and Adjustment in Tanzania (New York University Press, 1993) by **Alexander H. Sarris**, '70, SM '71, PhD '77, and Rogier van den Brink was published in September. An NYU News Release states: "Tanzania is now the fourth poorest country in the world. Its economic development, since independence in 1961, has been characterized by a series of internal and external shocks that have tested the resilience of the economy, the stability of its institutions, and the tolerance and inventiveness of its people. [The book] presents information that will have profound implications for economic policy in Tanzania. This study outlines the structure of Tanzanian economy and considers the impact of previous policies and current stabilization and adjustment measures on the poorer segments of the Tanzanian population." Sarris is a professor of economics at the University of Athens in Greece. He has held numerous consulting appointments with the World Bank, the Food and Agriculture Organization of the UN, and the International Fund for Agriculture Development. He is the author of eight books including *Ghana Under Structural Adjustment*, also published by the NYU Press. . . . **Michael Kuelwein**, PhD '88, has been promoted from assistant to associate professor of economics at Pomona College in Claremont, Calif. Kuelwein joined the faculty in 1987.

XV MANAGEMENT

Thomas Caruso, SM '84, writes: "Leslie and I bought a condo in Cambridge in August 1992. I am going on my fifth year at National Computer Systems, where I am a planning and information systems specialist. Four of these years have been spent doing budgets for $30 million business, and implementing project management and sales information systems. I have built a Lotus Notes Network with almost 30 users, and hope to have 50 by the end of the year. I am learning to sail on the Charles." . . . **Thomas D. Gros**, SM '89, is a trader with British Petroleum in Houston, Tex. . . . **Mats G. Lindquist**, '77, writes: "I have taken on a position as director for Lönn & Partners—a company that is in the international real-estate consultancy business. During the fall semester I will hold the chair as professor of library and information science at Åbo Akademi in Finland." . . . **Dennis L. Meadows**, PhD '69, has been named to the board of directors of Blue Cross and Blue Shield of New Hampshire. He continues as professor of business systems and director of the Institute for Policy and Social Science Research at the University of New Hampshire. . . . **Robert B. Hedges, Jr.**, SM '84, has been appointed executive VP of the Consumer Banking Group at Shawmut National Corp. in Hartford, Conn. He was VP of First Manhattan Consulting Group in New York City. . . . **Magid M. Abraham**, SM '82, PhD '88, takes on new responsibilities at Information Resources, Inc., in Chicago. He is now president, COO, and member of the board of directors; he was formerly group president for the Information Resources Group. . . . **Charles R. Bland, Jr.**, SM '80, is VP for the Asia/Pacific Division at Owens-Corning Fiberglass Corp. in Toledo, Ohio. He was previously VP and controller at the firm. . . . **Frederick L. Pugliese**, SM '86, has been elected town clerk of the Town of Watertown in Mass. He was deputy director of information services at the Massachusetts Bay Transportation Authority in Boston. . . . **Stuart H. Sadick**, SM '81, has been appointed corporate director of recruiting at the San Francisco office of CSC Index, a management consulting firm. Sadick has advised senior management of *Fortune* 500 corporations for more than 12 years on issues of human resources, executive team building, and organizational development. Prior to joining CSC Index, he was managing director of Chartwell Partners International, a San Francisco executive search firm. . . . **William F. Pounds**, a Course XV professor, has been elected to the board of directors at PerSeptive Biosystem. Pounds, a former president and CEO of Rockefeller Financial Services and former dean of the Sloan School, is currently on the board of directors at the Sun Company, Inc., IDEXX Laboratories, Inc., and Fisher Price, Inc. . . . **John J. Legere**, SM '93, has been assigned as the regional managing director for AT&T Consumer Services in the Asia/Pacific region. Legere was general manager of sales from 1989–91, responsible for sales covering all AT&T business communications systems consumers in New Jersey. He was named top general manager in the United States in 1991. . . . **Eva Csizinszky**, SM '92 (III), SM '92, has been appointed superintendent of manufacturing at the Delco Chassis Division of General Motors Corp. in Kettering, Ohio. Csizinszky is in charge of power boosters for brakes, and as such she is the woman in the highest level of management at this plant. The facility has a total of 1,500 employees, one-third of whom fall under her responsibility. . . . **Steven Latter**, SM '82, writes: "Although the recently published Alumni directory listed me as among the missing, I am still living in Westwood, Mass., with Mary Ann and our three children—Greg, ll; Mark, 9; and Caitlin, 4 1/2. I've been working in sales for the last six years with Sun Microsystems and it's been great working for a young, high-growth, high-tech company. Also, I serve as the president of Westwood Youth Soccer, and coach other youth sports with my kids. We spend most of the summer at our Cape house in Falmouth. Look us up if you're in the area." . . . Penney and **Jeremy Cohen**, SM '88, have a daughter, Michelle, born January 8, 1993. Jeremy is an advisory knowledge engineer for IBM's Applied Manufacturing Technologies Group in Atlanta.

Eric T. Olsen, SM '83, of Stow, Mass., died on June 15. Since 1984, he had served as director of manufacturing and operations at Drytek, Inc., in Wilmington, Mass. From 1981–84, he was engineering manager and design engineer for Unitrobe Corp. in Salem, and from 1978–81 he was employed as a microelectronics engineer at Raytheon Co., missiles system division. Olsen was a member and former chair of the board of governors of the Phoenix S.K. Club in Cambridge. He was also treasurer and one of the key founders of the TQM-BASE Council, Inc., helping to accelerate the TQM process within Boston-area semiconductor equipment companies. . . . **Lance K. Heiko**, SM '75, of Newton Center, Mass., died on July 10. Heiko had been associate professor of production and operations management at Bryant College since 1986 and in academia for all of his professional life.. He was assistant professor of management, mathematics, and science at Babson College in Wellesley, Mass., from 1983–86, visiting assistant professor at the graduate school of management at Simmons College in Boston in 1983 and lecturer at the University of Massachusetts at Boston in 1982. He was professor of operations management at the Arthur D. Little Management Education Institute, Inc., in 1981, visiting professor of physics and C.R.B. at the University of Louvain-la-Neuve, Belgium from 1973–74. Prior to that he was in a variety of educational institutions, including stints in Mexico City and Bonn, Germany. . . . **Edward A. Beddall**, '69, of Kennett Square, Pa., died on December 31, 1992. Beddall worked for Eversharp, Inc., makers of Schick shaving products. He retired after his company merged into Warner-Lambert.

Sloan Fellows

Hilmar B. Christianson, SM '53, writes from Sun City West, Ariz.: "Much travel as a retiree. In the past year to Austria, Germany, and Slovakia with my former church choir. Then New Zealand, Australia, many islands, Singapore—a most beautiful city. Tangier, the Canary Islands, Gibraltar. Then Israel, Turkey, Greece. Lastly Texas, Iowa, Illinois, Missouri. Next Mexico, Kentucky, California, and a secret destination." . . . **Philip B. Fletcher**, SM '70, has been named chair and CEO at ConAgra, Inc., in Omaha, Nebr. Prior to this he was president and CEO of the firm. . . . **William F. Reddersen**, SM '82, is senior VP for Broadband Strategies at BellSouth Corp in Atlanta, Ga. Previously he was president of BellSouth Business Systems. . . . Three MIT alums have been promoted at General Motors Corp. **Homi K. Patel**, SM '79, has a new position as general manager of manufacturing operations in the Powertrain Division Headquarters located in Pontiac, Mich. He was general manager of the Saginaw Division prior to this. **John J. Wetzel II**, SM '73, is corporate VP for North American Central Engineering and New Vehicle Development in Warren, Mich. He was at GM's Troy, Mich., plant as VP and director of engineering of the Saturn Division. Wetzel is taking over for **Donald L. Runkle**, SM '76, who has been named VP of the Saginaw Division. . . . **Brian J. Kelly**, SM '73, is group president of network operations at Bell Atlantic Corp. Previously he was VP for administration at the Arlington,Va.-based company. . . . **Bruce S. Gordon**, SM '88, also at Bell Atlantic, leaves his position as VP for sales to assume the presidency of consumer services. . . . **Nicholas J. Neuhausel**, SM '91, has been named senior VP for human resources and administration at Transco Energy Co. in Houston, Tex. He was VP at Sun Company, Inc., in Philadelphia. . . . **James T. Johnson**, SM '77, is executive VP at Pratt & Whitney and president of Pratt & Whitney Commercial Engine Business in East Hartford, Conn. He comes from Seattle, Wash., where he was VP and general manager of the Everett Division at Boeing Commercial Airplane Co. . . . **Richard E. Disbrow**, SM '65, is chair of InterSource Technologies, Inc., in Sunnyvale, Calif. Previously, he was chair and CEO of the American Electric Power Co, Inc., in Columbus, Ohio. . . . Sister **Mary Norberta Malinowski**, SM '80, has been awarded an honorary doctorate in business administration from Husson College in Bangor, Maine. Malinowski is president of St. Joseph Hospital and St. Joseph Healthcare Foundation in Bangor. She was cited for "a life of faith, success in the field of health, leadership in education, and service to [her] community..." Malinowski joined St. Joseph in 1980 as associate executive director and has risen steadily to her current position. Under her leadership the hospital has expanded its service to the Bangor community through the establishment of the Healthcare Foundation and the Center for Advanced Medicine. The hospital has become a leader in hospice, lithotripsy, ambulatory services, physical and occupational therapy, and women's healthcare. . . . **Jonathan R. Yates**, SM '82, was the managing director of *Nostalgia: A Musical Revue*, which ran from July 9 to August 1 at the Chiswick Park Theatre in Sudbury. Among his directing credits are *Luv, Twelfth Night, No Exit, A Phoenix Too Frequent*, and several Gilbert & Sullivan operas. He co-produced and directed *Lenny* in Boston and in London, *Slow Dance on the Killing Ground* with Clarence Williams III and Werner Klemperer, and *The Drunkard* with the Next Move Theatre at the Charles Playhouse. Yates also co-produced *Arturo Ui* starring Al Pacino, *Dance of Death* starring Colleen Dewhurst, and several others.

George B. Stone, SM '58, of East Moriches, N.Y., died on June 25. He retired in 1978 as senior VP and former member of the board of Pfizer, Inc. He was a member of the Chemists' Club and the American Pharmaceutical Society. Stone served during WWII in the C.B.I. Theatre as a meteorologist and was discharged with the rank of major. . . . The Association of Alumni and Alumnae has been notified that **Karl R. Merill**, SM '66, died on May 9. No further information was provided.

Senior Executives

Jim Harty, '76, writes: "I was active at MIT until I took early retirement from the Raymond Corp. seven years ago. In 1987 I received the MIT Distinguished Corporate Leadership Award for the work I had done in the behavioral science area at MIT and the Raymond Corp. When I retired, I moved to Hilton Head, S.C. . . . **Mark van Mens**, '81, retired in April 1993 as personnel director at Dutch Unilever. . . . **Ronald A. Rogers**, '92, has been named VP for engineering in the Saturn Division of General Motors in Troy, Mich. He was previously director of product engineering for the same division. . . . **Patrick Courtin**, '81, has resigned as president and CEO at Proteon Associates, Inc., in Westborough, Mass. . . . **Earle Mauldin**, '87, is executive VP and CFO at BellSouth Corp. He had been group president of mobile systems in the company's Atlanta office. . . . **Donald M. Roberts**, '71, has been named to the board of directors of Burlington Resources, Inc., in Seattle, Wash. Roberts continues as vice-chair and treasurer at U.S. Trust Corp. in New York City. . . . **Michae F. Mee**, '84, has resigned as chair and CEO at Wang Laboratories in Lowell, Mass. . . . **Samuel B. Coco, Jr.**,

'64, former president of Cabot Corp. in Boston, has been named to the board of directors at XLI Corp., in Woburn, Mass.

The Association of Alumni and Alumnae has been notified of the following deaths: **Robert P. Cross**, '59, of La Grange, Ill., on April 29, 1989; **Haimo Fortmann**, '89, of Hannover, Germany, on August 12, 1992; and **Lawrence A.P. Smith**, '69, of Baie d'Urfe, Quebec, on May 29.

Management of Technology Program

Sorab R. Vatcha, SM '85 (X), recently published an article in CHEMTECH ("Competitive Technology Intelligence," May 1993). He tells us that in writing the article, he "drew upon and developed several useful concepts that I first learned about in the MOT Program." Sorab also joined the Sloan Alumni Club in Northern California, and attends meetings whenever he can. . . . **Malcom L. Sims**, SM '87, has accepted a new post at King's College, London. The job is to promote industrial collaboration and introduce good management practices to research contract negotiation and related IPR issues. He writes that "it will be quite a challenge, but one I should enjoy." He is now the managing director of KCL Enterprises, Ltd., at King's College, London. . . . **Hiroyuki Akiyama**, SM '91, recently moved into his own house in Kanagawa, west of Tokyo. He is still working at the corporate planning office, and is responsible for developing the Xerox-Fuji Xerox strategic partnership. . . . **Andries Botha**, SM '92, attended a summer course at MIT in July 1993. He visited the MOT Program office to talk about the program and his experiences as a MOT student. . . . **Koichi Hagishima**, SM '92, reunited with other MOT alumni in Tokyo in June 1993. The party was very private and was held in a funky restaurant selected by **Takao Kase**, SM '92. The other members were **Tak Kai**, **Toshihiko Shoyama**, and **Hirosh Shiroi**, all SM '92. . . . Takao Kase also wrote to let us know that he is now working with a small patent bureau in Tokyo, and misses the life at MIT. He tells us that '92 MOT alumni in Japan often meet to eat and drink together. . . . **David Isenhour**, SM '92, and his wife, Denise, visited the Program office in the final days of a New England vacation. They will be returning from Connecticut, where they spent the last year, to Austin, Tex. Denise has already accepted a position teaching fifth grade and David is deciding between several locations within IBM. David and Denise report regular contact with many classmates, including **Bruce Dewar**, **Tirso Palm**, **Joe DiTomaso**, **Joe Fitzgerald**, **Koichi Hagishima**, and **Jon Otterstatter**. It's nice to know the class of '92 stays in touch! . . . **Mark Lee**, SM '92, is founder and editor of *MSAD Process Improvement Tally*, a newsletter that is published by the Process Improvement Team at NASA. The team employs Total Quality Management as taught by Professor **Shoji Shiba** (a course Mark took as an elective during his year in MOT). In addition, Mark is conducting official TQM training sessions for his colleagues in various areas at NASA. . . . **Chris Firth**, '93, won an honorable mention (the ENNE Award at Sloan) for best thesis, and second place in a student essay competition conducted by IEEE/Computerworld/ NCR. He also let us know that he joined the MIT Club in Singapore, and heard **Lester Thurow** speak at a dinner talk at one of the alumni club meetings. . . . **Sigmund Kvernes**, SM '93, has been in contact with the President of the Norwegian Institute of Technology (NTH). They are designing a program "à la Management of Technology," beginning in 1994. . . . **Joe Londa**, SM '93, and his wife, Barb, are now the proud parents of Evan Patrick, who was born on July 19 weighing 7 lbs. . . . We are very sorry to report that **Bruce McHenry**, '83, SM '84, lost his father in June, 1993. . . . **Francis Yeoh** is "still trying to adjust back to the weather and work environment after a carefree year as a 'student.'" He tells us that he came back to Singapore at the wrong time "as far as the prices of cars and houses are concerned. They're just unbelievable!" He is trying to keep in touch with his MOT classmates through e-mail.—MOT Program, MIT, Room E56-290, Cambridge, MA 02139.

XVI AERONAUTICS AND ASTRONAUTICS

Scott Sandler, SM '92, is a product engineer at Ford Motor Co. in Dearborn, Mich. . . . **Joseph D. Antinucci**, SM '65, has been named corporate VP at the Martin Marietta Corp. in Bethesda, Md. Previously, he was president of Martin Marietta Electronic Systems in Orlando, Fla.

XVII POLITICAL SCIENCE

Paul Walker, PhD '78, has been named policy director of the House Armed Services Committee, the committee that oversees the defense budget, by Rep. Ronald Dellums (D-Calif.), a dissident congressman who was named chair of the committee in January. Walker, an arms expert, called for drastic reductions in military spending during the height of the arms race. Known nationally for expertise in Soviet intelligence, He is founder of the Cambridge-based Institute for Peace and International Security. Walker, who has worked with Dellums for years, met the congressman after he cowrote *The Price of Defense*, a 1979 book calling for a 50-percent reduction in arms spending at a time when the Cold War was fueling unprecedented peace-time Pentagon spending. . . . **Edward R. Jayne II**, PhD '69, has been named president of Insituform Mid-America, Inc., in Chesterfield, Mo. Previously, he was VP for strategic planning at McDonnell Douglas Corp.'s Missiles Systems Division in Saint Louis, Mo.

Richard Solomon

Richard H. Solomon, '60 (XIV), PhD '66, has been selected as the new president of the U.S. Institute of Peace. Solomon's career has included positions in academia, public policy research, and senior levels of government. Most recently, he served as ambassador to the Philippines (1992–93) and assistant secretary of state for East Asian and Pacific affairs (1989–92). He was chosen out of a field of 200 candidates. As president, Solomon is CEO of the institute, whose activities include grant-making, fellowships, in-house research and analysis, public education projects, and library services. The institute has special programs involving peace and stability in the Middle East and Africa, rule of law, religion and human rights, and multilateral peacekeeping; it also publishes books, monographs, and special reports. As assistant secretary of state, Solomon negotiated the first UN "Permanent Five" peacemaking agreement for Cambodia and had a leading role in dialogue among the United States and North and South Korea, which led to inspections of suspected North Korean nuclear facilities. He also led U.S. negotiations with Japan, Mongolia, and Vietnam over important bilateral issues. In the Philippines, Solomon coordinated the closure of U.S. naval bases and developed a new framework for bilateral and regional security cooperation.

XVIII MATHEMATICS

Eric Reissner, PhD '38, professor emeritus of applied mechanics at the University of California at San Diego, writes: "The cryptic notice concerning the death of **Hubertus J. Weinitschke**, PhD '58, (*TR*, July 1993, page MIT 45), compels me, as his one-time thesis advisor, to write as follows. After receiving a Course XVIII PhD in 1958, Hubertus spent the next five years in California with Hughes Aircraft and as an assistant professor at UCLA. In 1963 he returned to his native Germany, to work with Lothar Collatz in Hamburg, before becoming professor of applied mathematics at the Technical University of Berlin. He left Berlin for Erlangen in 1977, where he remained until his untimely death during heart surgery. While in Erlangen he repeatedly had visiting appointments at the University of Washington in Seattle, the University of British Columbia, and UCLA. He will be remembered for a number of significant publications on problems of applied mathematics and mechanics, some of them jointly with [me], **Charles Lange**, PhD '68, and **Fred Wan**, '59, SM '63, PhD '65. On a personal note, he will be remembered as a caring friend, and as a dedicated and accomplished organist."

XX APPLIED BIOLOGICAL SCIENCES

James C. Leung, '75 (X), SM '77, PhD '82, has been appointed VP for process development with Repligen Cop. Leung is formerly an associate director with Genentech. In his role with Repligen, a new position, Leung will continue developing manufacturing procedures for the company's efforts against cancer, viral disease, inflammatory disorders, and cardiovascular conditions. Products in three of these areas are currently under study in the human clinical setting and the fourth product will be tested later in 1993.

XXI HUMANITIES

David Porush

David Porush, '73, professor of language, literature, and communications at Rensselaer Polytechnic Institute, has been named the winner of a Fulbright Award from the United States-Israel Educational Foundation. He will spend 10 months at the Technion in Haifa, Israel, teaching undergraduate and graduate level

SOLOMON PHOTO: TWIN LENS PHOTO

courses in liberal studies and science education. Porush is the author of *The Soft Machine: Cybernetic Fiction*, which studies the history of artificial intelligence and its effect on contemporary literature.

XXII NUCLEAR ENGINEERING

Martin Becker

The American Societyfor Engineering Education (ASEE) in Washington, D.C., has elected a new VP, **Martin Becker**, SM '62, PhD '64, dean of the College of Engineering at the University of Miami. As VP and chair of the Engineering Research Council, Becker will be responsible for four different councils on education relating to engineering: the Engineering Deans Council, the Engineering Technology Council, the Engineering Research Council, and the College Industry/Government Council. . . . From Virginia Beach, Va., **Ralph T. Soule**, SM '91 (VI), SM '91, writes: "I am the equivalent of a plant engineer for one of the USS *Enterprise*'s four propulsion plants; each includes two nuclear reactors, propulsion turbines, steam turbine generators, and support equipment. The *Enterprise* refueling and overhaul is the most complicated and technically challenging job of its kind ever undertaken by the Navy." . . . Lieutenant Commander **Richard D. Lantz**, SM '89, NE '89 (XIII), recently reported for duty at Naval Submarine Support Facility New London in Groton, Conn.

TPP TECHNOLOGY AND POLICY PROGRAM

Jonathan B. Weiss, '76 (I & XVII), SM '78, is assisting the Federal Employment Service of Moscow, Russia, in the planning of a pending World Bank loan. Jonathan would welcome hearing from anyone connected with MIT who will be in Moscow. They can write to him c/o FES, Suite 295, 208 East 51st Street, New York, NY 10022, or contact him once in Moscow at tel: 7-095-261-0125 (office), 7-095-242-4701 (home), or fax: 0-095-261-2464. He would be particularly pleased to assist anyone doing policy research work in Russia.

Robert S. Chen, '76, SM '82 (XII), SM '82, has left the Alan Shawn Feinstein World Hunger Program at Brown University to take up a position as director of interdisciplinary research at the Consortium for International Earth Science Information Network (CIESIN) in Saginaw, Mich. CIESIN's mission is to facilitate access and use of data and information about the human dimensions of global environmental change. . . . **Francois Jacques**, SM '85, is now the director of corporate planning and development at Ciments Lafarge in Saint Cloud, France.

Caleb King, SM '90 (I), SM '90, is finishing Harvard Medical School with an MD and will be starting his residency at the Children's Hospital of Boston. He is engaged and will soon be married to Louise, who will be a resident at Brigham and Women's Hospital. . . . **Shinji Nambo**, SM '90, is continuing to work as a consultant for developing countries in the field of industrial development, as well as enviromental protection.

Susan and **Jamie Winebrake**, SM '91, have an additon to their family. James Patrick was born on May 31. . . . **Eugene Bae**, SM '93, has been assigned to the environmental technology group at the Pentagon, where he is working to establish DOD's technical requirements for S&T research monies in environmental areas.—Richard de Neufville, TPP, MIT, Room E40-252, Cambridge, MA 02139.

Deceased

The following deaths have been reported to the Alumni/ae Association since the *Review* last went to press:

George Michelson, '19; July 6, 1993; Brookline, Mass.
Donald D. Way, '19; July 1, 1993; Westfield, N.J.
Allen A. Parker, '23; June 13, 1993; Lynnfield, Mass.
Rutilio Torres-Saravia, '24; June 17, 1993; Guadalajara, Mexico
Frederick W. Greer, '25; July 3, 1993; Nashua, N.H.
Rufus N. Palmer, '25, ScD '38; July 3, 1993; Pittsburgh, Pa.
George A. Booth, '26; June 29, 1993; Worcester, Mass.
Ronald J. Martin, '26; July 9, 1993; Elizabethtown, Tenn.
John V. Masterman, '26; June 30, 1993; Needham, Mass.
Frederick W. Byron, '27; July 17, 1993; Amherst, Mass.
William B. Duffy, '27; June 19, 1993; North Andover, Mass.
Butler King Couper, '29; June 18, 1993; Tryon, N.C.
Anthony Standen, '29; June 22, 1993; South Kent, Conn.
Hans K.R. Witschel, '29; June 14, 1993; Lawrence, Mass.
John M. MacBrayne, Jr., '31; June 11, 1993; Camden, Mass.
Herbert H. Uhlig, Phd '32; July 3, 1993; Hancock, N.H.
Ernest Di Paolo, '34; June 27, 1993; Danvers, Mass.
Charles H. Lucke, Jr., '35; July 18, 1993; Stratford, Conn.
Alan McCullough, '34; July 11, 1993
Aaron K. Redcay, '34; June 30, 1993; Beverly Hill, Fla.
John B. Rippere, Jr., SM '39; October 26, 1992; Long Beach, Calif.
Joseph F.R. Weston, '39; July 4, 1993; Monument Beach, Mass.
Alfred J. Rice, '40; March 26, 1993; Greensboro, N.C.
John E. Tyler, '40; June 27, 1992; La Jolla, Calif.
Lawrence E. Welch, '40, SM '41; July 13, 1991; Ponce, Puerto Rico
Franklin K. Pittman, PhD '41; June 27, 1993; Oklahoma City, Okla.
Jeanette H. Levens, MPH '42; May 25, 1993; Marina Del Rey, Calif.
Kenneth R. Gifford, '43; June 22, 1993; Farmingdale, Maine
Henry Steinhauer, Jr., '43; May 2, 1993; Oak Ridge, Tenn.
Arthur J. Slemmons, '44; February 19, 1993; Los Gatos, Calif.
Howard A. Mermelstein, '45; May 5, 1991; Pittsburgh, Pa.
Robert E. Byram, '49; June 27, 1993; Lancaster, Pa.
Robert W. Davison, PhD '50; June 25, 1993; Wilmington, Del.
Rai Y. Okamoto, MAR '51; July 7, 1993; San Francisco, Calif.
William T. Rusch, '52, SM '53; July 16, 1993; Center Harbor, N.H.
Michael A. DeSesa, PhD '53; June 30, 1993; Brookline, Mass.
George B. Stone, SM '58; June 25, 1993; East Morches, N.Y.
Robert P. Cross, '59; April 29, 1989; La Grange, Ill.
Stephen F. Schmelzer, '65; June 15, 1993; Maplewood, N.J.
Karl R. Merill, SM '66; May 9, 1993; Fort Worth, Tex.
Lance K. Heiko, SM '75; July 10, 1993; Newton Center, Mass.
David W. Tong, SM '71, EE '72, PhD '75; June 5, 1993; Scotia, N.Y.
David E. Plotnick, '80; February 9, 1993; Columbia, Md.
Eric T. Olsen, SM '83; June 15, 1993; Stow, Mass.
Haimo Fortmann, '89; August 12, 1992; Hannover, Germany

ALLAN J. GOTTLIEB, '67

Kissing Cosines

Hello from the land of boxes. My wife, Alice, has accepted a position as associate medical director of Roche Dermatologics (the dermatology division of the Hoffman LaRoche drug company) and we have moved to New Jersey! As many of you can well imagine, the local recycling center will be well supplied with cardboard and packing paper.

Problems

N/D 1. Lester Steffens wonders what is the highest score a Bridge pair can obtain on a single hand (excluding illegalities and penalties for reneging, etc.) when neither of them has a card higher than a ten.

N/D 2. Nob. Yoshigahara wants you to substitute the digits 1–9 once each in the following equation.

$$\frac{AB}{CDE}+\frac{FG}{HI}=7$$

N/D 3. John Rule has a point P situated inside a square ABCD so that PA=1, PB=2, PC=3. He wants you to calculate angle APB "using only the methods of Euclid."

Speed Department

Here is a "mental creativity challenge" from my NYU colleague Ron Bianchini. Each item contains the initials of words that make it correct and you are to fill in the words. For example, given "16 = O. in a P." the answer is "Ounces in a Pound." Now try the following five examples: "9 = P. in the S. S."; "88 = P. K."; 13 = S. on the A. F."; "32 = D. F. at which W. F.," "18 = H. on a G. C."

Solutions

JUL 1. We begin with a well-known computer problem suggested by the late Robert High:

In your favorite programming language (C, Lisp, Apl, etc.) write a program that, when run, produces output that is an exact copy of its own source code. Calls to system functions to "echo" the source from a file are not in the spirit of the problem!

Although I personally use C more than Lisp, my conversion to the Emacs "editor" has somewhat rekindled a love of Lisp that I had as an MIT undergraduate. The Lisp solution from Walter Hamscher also appeals to me. Hamscher writes:

I've never sent a response to any of the puzzles in your column till now—this problem concerning self-duplicating code was just too easy an opportunity to advertise my favorite language, Lisp:

```
((lambda (x) (list x (list (quote quote) x)))
(quote (lambda (x) (list x (list (quote quote) x)))))
```

Here is a C solution from Scott Brown:

```
char a[]="char a[]=;main()
{printf(a+48,a,34,a,34,10,a+9);}
%.9s%c%s%c%c%.39s"
;main(){printf(a+48,a,34,a,34,10,a+9);}
```

JUL 2. A "classic" from Gordon Rice:

While cleaning out my office for retirement, I came across my freshman physics text, *Introduction to Mechanics and Heat*, 2nd edition, 1939, by N.H. Frank. On page 204 is the following gem:

A slender homogeneous rod of length 60 cm., resting on a perfectly smooth horizontal surface, is struck a blow at right angles to the length of the rod at one end of the rod. Find the distance through which the center of the rod moves while it makes one complete revolution.

The following solution is from Matthew Fountain:

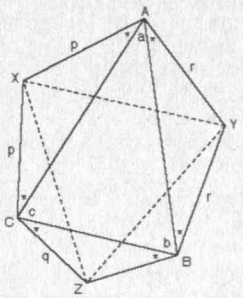
The center of the rod moves 62.8 cm. The force F on the end of the rod normal to its length imparts an acceleration a to the center of the rod equal to F/M, m being the rod's mass. As F is 30 cm. out of line with the center of gravity of the rod, F produces a torque $T = 30F = 30\,ma$ on the rod. Recalling that the definition of "moment of inertia" is "the ratio of the torque applied to a rigid body free to rotate about a given axis to the angular acceleration thus produced about that axis and equal to the sum of the products of each element of mass by the square of its distance from the given axis," we may write: $(30ma)/(d\omega/dt) = \int_0^{30} mx^2dx = 300m$. Therefore $d\omega/dt = 30ma/300m = a/10$.

Although a sharp blow exerts a varying force, at every instance the ratio of rotational acceleration to the acceleration of the center of gravity remains constant, and consequently the velocity of rotation in radians is at each instant equal to one-tenth the velocity of the center of the rod in centimeters. In the time it takes the rod to rotate 2π radians the center of the rod advances $20\pi = 62.8$ centimeters.

JUL 3. Consider an arbitrary triangle ABC. From each of the vertices, extend two lines on the exterior of the triangle, each at a 30-degree angle from the sides. These lines intersect at the points X, Y, and Z opposite sides AB, BC, and CA. Show that triangle XYZ is equilateral.

Howard Stern sent us a nicely done solution, reprinted below.

Consider the accompanying diagram:



where △ABC has angles {a,b,c}, angles denoted by a "*" are 30°, and we are to show △XYZ is equilateral.

Lengths {p,q,r} are labelled as such because △s AXC, BCZ, and AYB are isosceles. In addition, by the Law of Cosines we have:

$$p=\frac{AC}{\sqrt{3}}\qquad q=\frac{BC}{\sqrt{3}}\qquad r=\frac{AB}{\sqrt{3}}$$

Applying the Law of Cosines again we have:

$XY^2 = p^2+r^2-2pr\text{Cos}(60°+a)=$

$$\frac{AC^2}{3}+\frac{AB^2}{3}-\frac{2(AC)(AB)}{3}\left\{\frac{1}{2}\text{Cos}(a)-\frac{\sqrt{3}}{2}\text{Sin}(a)\right\}$$

But $\text{Cos}(a)=\dfrac{AC^2+AB^2-BC^2}{2(AC)(AB)}$ using the Law of Cosines.

Also $\dfrac{\text{Sin}(a)}{BC}=\dfrac{\text{Sin}(b)}{AC}=\dfrac{\text{Sin}(c)}{AB}=Q$ (some constant) by the law of Sines.

Substituting and simplifying we get:

$$XY^2=\frac{AC^2}{6}+\frac{AB^2}{6}+\frac{BC^2}{6}+\frac{\sqrt{3}}{2}Q(AC)(AB)(BC)$$

Due to the symmetry of the problem, solving for the other sides: XZ or YZ yields exactly the same expression. Thus the three sides are of equal length, implying △XYZ is equilateral.

Better Late Than Never

F/M 3. Harold Boas has located references to a variant of this problem that appeared on the Cambridge Math Tripos Exam in 1871 so problems like this have been around for over a century.

JUL SD. Tim Johnson was able to generalize this problem to the case where an unknown number of the M jars have weight A and the remaining jars have weight B for arbitrary M, A, and B.

Other Responders

Responses have also been received from H. Boas, E. Dawson, W. Hartford, R. Hess, H. Hodara, R. Hoffman, T. Johnson, N. Megill, D. Miller, R. Moeser, G. Neben, S. Ponzio, J. Prussing, K. Rosato, E. Sard, A. Ucko, and C. Wampler.

Proposer's Solution to Speed Problem

"Planets in the Solar System," "Piano Keys," "Stripes on the American Flag," "Degrees Farenheit at which Water Freezes," "Holes on a Golf Course."

SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO ALLAN J. GOTTLIEB, '67, THE COURANT INSTITUTE, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y. 10012, OR TO: GOTTLIEB@NYU.EDU

MIT LIFE INCOME FUNDS

MR. JOHN H. WILLS

HOME: Colorado Springs, Colorado

CAREER: The year after he graduated, Mr. Wills, MG '26, served as an assistant for Course XV while doing graduate work at Harvard. He then worked in banking and investment counseling in Boston and New York before entering Princeton in 1938 to complete his graduate work in economics. In 1943, he joined the Northern Trust Company in Chicago. He served on the general policy and principal bank and trust investment policy committees and as editor of the bank's monthly *Business Comment*, before retiring in 1970 as senior vice president and chief economist. After he retired, he served as an expert witness in utility rate cases and worked with a financial services consulting firm. Mr. Wills has been a director, treasurer and president of the MIT Club of Chicago. In all these efforts he says: "I had the loving helpfulness of my wife Ellen."

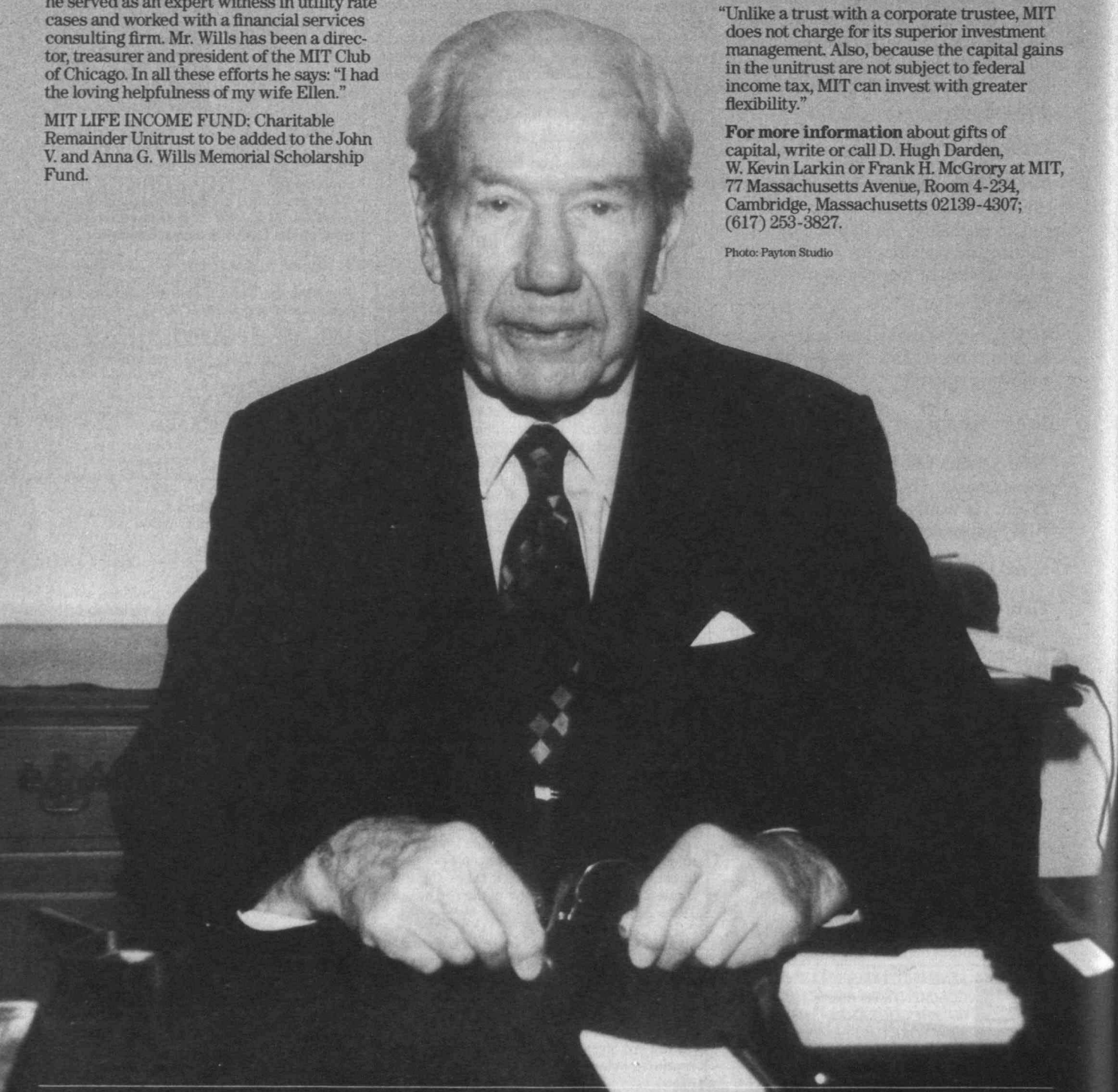
MIT LIFE INCOME FUND: Charitable Remainder Unitrust to be added to the John V. and Anna G. Wills Memorial Scholarship Fund.

QUOTE: "I had four objectives for my recent giving to MIT: to honor my mother and father, whose thriftiness and devotion allowed me to attend MIT; to augment MIT's financial aid program; to reduce federal and state income and estate taxes; and to provide some secure income for our daughter. I accomplished the first three by establishing a memorial scholarship fund honoring my parents and the fourth by establishing a charitable remainder unitrust, with our daughter as the life income beneficiary. The scholarship fund is the ultimate recipient of the principal.

"Unlike a trust with a corporate trustee, MIT does not charge for its superior investment management. Also, because the capital gains in the unitrust are not subject to federal income tax, MIT can invest with greater flexibility."

For more information about gifts of capital, write or call D. Hugh Darden, W. Kevin Larkin or Frank H. McGrory at MIT, 77 Massachusetts Avenue, Room 4-234, Cambridge, Massachusetts 02139-4307; (617) 253-3827.

Photo: Payton Studio



DONOR'S PROFILE

SAVE money and time with *on-line* trading through QUICK & REILLY.

There are a lot of advantages to using Quick Way—Quick & Reilly's on-line, 24-hour brokerage service:

- Save substantially on commissions.
- No start-up or monthly subscription charges.
- Access to quotes on any listed stock, option, or market index.
- Place orders on your PC in seconds—day or night. Reports are returned on-line.
- Prices of up to 18 stocks, plus options, on a single screen.
- Bypass your computer and get one-to-one service from a Quick & Reilly Personal Broker.

COMPARE AND SAVE*

	100sh @ $40	300sh @ $30	1000sh @ $20
QUICK & REILLY	*$49*	*$82*	*$109*
Charles Schwab	55	107	144
Merrill Lynch	100	204	374

For our complete information package describing the benefits of Quick Way, plus everything you need to open an account, call 1 800 334-1924 ext 5120.

QUICK & REILLY
A NEW BREED *of* BROKER℠
Information not advice.

For Information, Call 1 800 334-1924 Ext 5120

Over 90 Offices Nationwide. Member New York Stock Exchange/SIPC.

*Standard phone order for stock transactions. Telephone survey 2/93. Minimum commissions: $37.50 per trade. ©1993 Quick & Reilly, Inc.

Take a year... to make a difference.

If you're interested in an opportunity to work in the White House and deal one-on-one with America's leaders, take a close look at the White House Fellowships.

White House Fellows are a select group of men and women who spend a year early in their careers serving as paid assistants to the President, Vice-President, or cabinet-level officials.

They are people of exceptional abilities, strong motivation and a desire to serve their country.

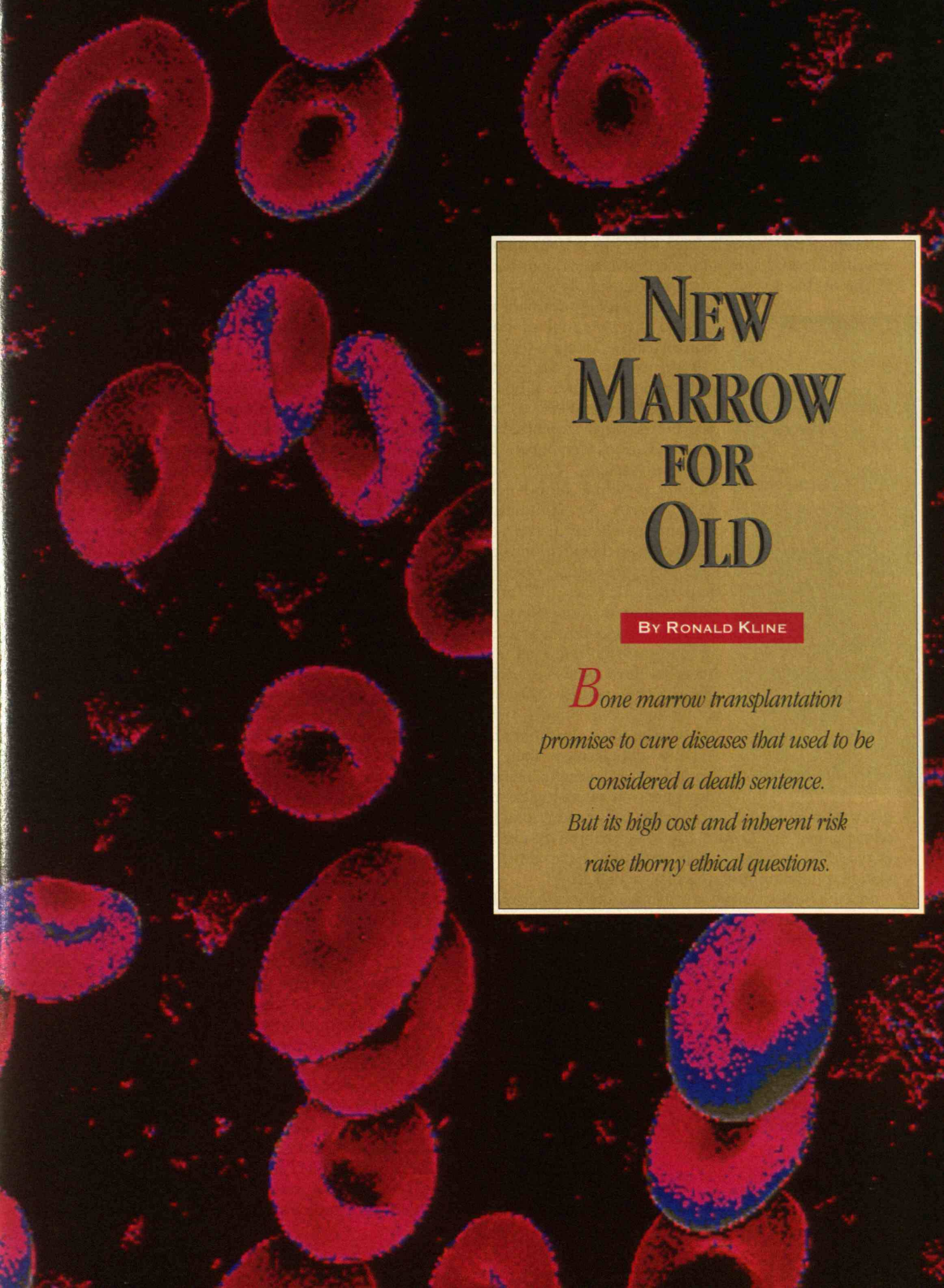
White House Fellows have gone on to become leaders in many fields... business, politics, science and the arts. And they all agree on one thing: Their year as a Fellow changed their lives.

If it often seems as though you have to choose between helping others, and helping yourself—here's a chance to do both. As a White House Fellow, you can serve America while learning skills you will use your entire life.

And instead of just reading about world events, you can help shape them.

Call (202) 395-4522 for a brochure, application and the opportunity of a lifetime.

THE WHITE HOUSE FELLOWSHIPS



New Marrow for Old

By Ronald Kline

Bone marrow transplantation promises to cure diseases that used to be considered a death sentence. But its high cost and inherent risk raise thorny ethical questions.

EARLY in the next century, children born with sickle cell anemia will have bone marrow taken from their bodies, corrected in vitro with genetic engineering, and reinfused. Leukemia patients will receive chemotherapy and then a reinfusion of their own marrow, cleansed of malignant cells. An infant born without an immune system will be cured by an infusion of marrow cells from a healthy infant's umbilical cord blood, frozen and stored in a large donor bank. None of this is science fiction, but simply science, as advances in biology dramatically expand the potential of bone marrow transplantation (BMT).

Donor marrow produces a transplanted immune system—often one that sees its host's entire body as foreign and reacts against it. But for leukemia patients, that can be a godsend.

Bone marrow, the red, spongy material in the center of bones, produces red blood cells as well as platelets, which stop bleeding, and the various elements of the immune system, collectively known as white blood cells. BMT works by eliminating unwanted cells in the marrow and replacing them with healthy cells. The procedure can also help treat diseases like brain tumors that do not affect the marrow: a patient's marrow can be temporarily removed and frozen to allow intensive chemotherapy that would otherwise prove toxic to it. Finally, BMT has been used to treat inherited enzyme deficiencies such as Hurler's syndrome, which results in progressive neurological degeneration and death. In this case, cells produced in the transplanted marrow are used to distribute the crucial enzyme. These cells also help metabolize the toxic products that build up from the enzyme deficiency.

Indeed, bone marrow transplantation offers cures for a range of diseases that used to be universally fatal. But it brings with it a new set of technical and ethical problems. Thus issues involving when and how to use the procedure are becoming controversial, both inside and outside the medical community.

Getting Treatment to Work

The theoretical foundations for human bone marrow transplantation were established in the early 1950s with the research of biologist Delta Uphoff of the National Cancer Institute, biologist Leon O. Jacobsen of the University of Chicago, and E. Donnall Thomas, a medical oncologist at Seattle's Fred Hutchinson Cancer Center who won the 1990 Nobel Prize in medicine for his work. One series of experiments showed that mice subjected to lethal irradiation would live if a single marrow-containing limb were shielded. Another series showed that the mice were also protected when marrow from a similar strain of mouse was injected following irradiation. If marrow from a different strain of mouse was injected, however, they died. This was the first observation of a phenomenon called Graft versus Host Disease (GVHD), which remains a problem to this day.

Bearing in mind that the marrow produces white blood cells, and that therefore one essential result of BMT is a transplanted immune system, GVHD can be thought of as organ-graft rejection in reverse. In other words, just as a host's immune system will recognize a transplanted liver or heart as foreign tissue and react against it, a transplanted immune system will recognize a host's entire body as foreign tissue and react against it. In humans, acute GVHD manifests itself in one of three ways: a skin rash that can progress to blistering and ulceration, liver damage that can progress to liver failure, and damage to the intestinal lining that can lead to massive gastrointestinal bleeding. Chronic GVHD, which shows up 100 days or more after a transplant and can either follow an episode of acute GVHD or arise spontaneously, has symptoms that resemble those of autoimmune diseases like lupus and scleroderma, including severe rashes, thickening and scarring of the skin, and limitation of joint motion.

After years of experiments in dogs, BMT was first attempted with limited success on humans with end-stage leukemia. The first truly successful bone marrow transplants were performed in 1968 in children with immunodeficiency disorders. Since that time, applications of BMT have expanded dramatically, with over 5,000 transplants worldwide each year.

But treatment is hampered by the difficult matter of precisely matching donor and host to minimize the often fatal complications of GVHD. The greatest likelihood of a match is between two siblings, since they've received genetic material from the same two parents. Yet even among siblings, the probability of a correct match is only 25 percent, and then there is still a 10 to 20 percent chance of life-threatening GVHD. This is thought to occur because of a mismatch between minor proteins that the matching process does not consider. The close genetic relationship of siblings ensures that many of these minor proteins will be matched simply by random chance. When donor and recipient are unrelated, as in the case of BMT using marrow from a donor bank, the incidence of severe GVHD from a mismatch between such proteins climbs to 80 percent.

RONALD KLINE is a pediatric hematologist/oncologist and bone marrow transplant physician at Sunrise Children's Hospital in Las Vegas, Nev.
He is grateful for the assistance of Rachel Kline in preparing this article.

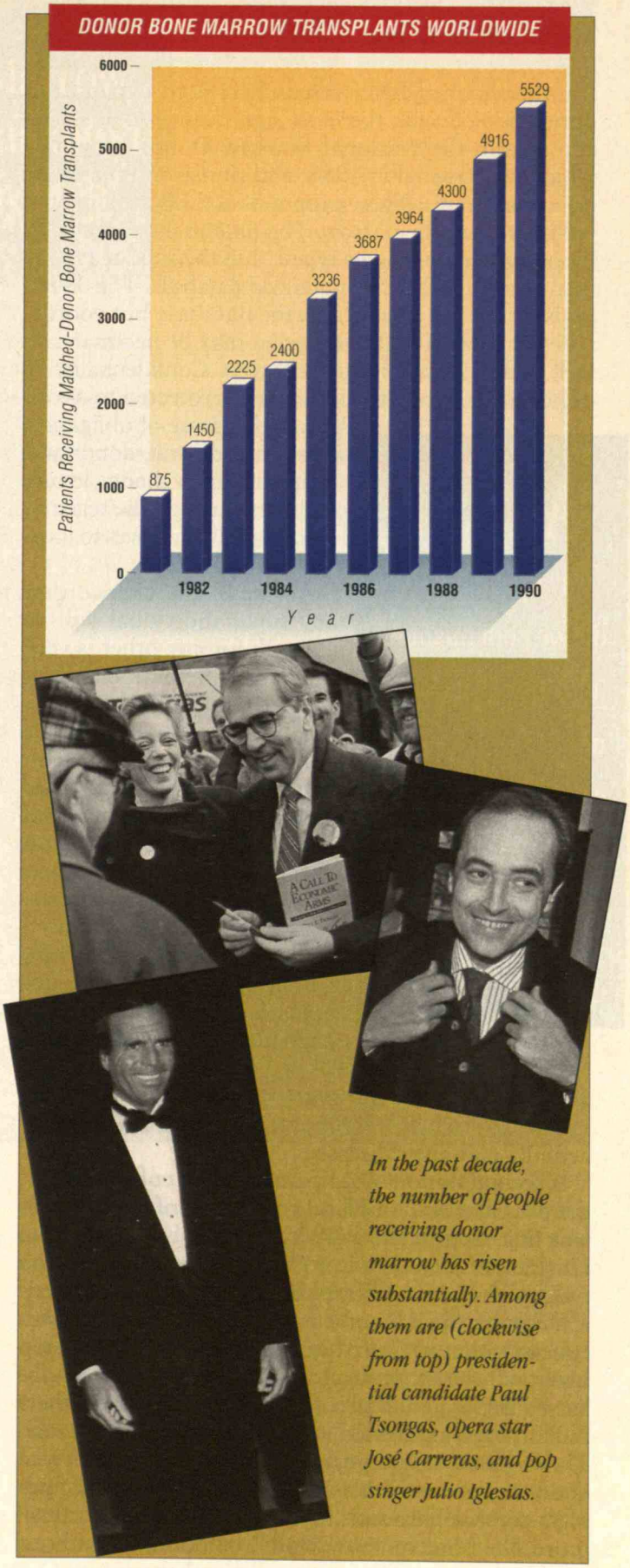
PHOTO OF HUMAN RED BLOOD CELLS (PREVIOUS PAGE): ROBERT BECKER/CUSTOM MEDICAL STOCK

Not surprisingly, then, one of the major goals of BMT research is to better treat and prevent GVHD. The acute form of the condition can often be prevented with methotrexate and cyclosporine, which moderate the effects of the transplanted immune system. Methotrexate is an anticancer drug lethal to rapidly growing cells, including the donor immune cells that recognize foreign proteins in a recipient's body and proliferate in response. Cyclosporine, widely used to stave off graft rejection in organ transplantation, appears to work by interfering with the cascade of intracellular events that activate the immune system.

When acute GVHD cannot be prevented, it can be treated with steroids that suppress the response of the transplanted cells. Or a substance known as antithymocyte globulin (ATG) can be administered. ATG consists of antibodies to the human white blood cells known as thymocytes, or T cells, which cause GVHD. Such cells are injected into a horse, whose immune system recognizes them as foreign and generates antibodies—ATG—against them. A third possibility for treating acute GVHD comes from immuno-conjugates, a new class of compounds that consist of an antibody molecule chemically linked to a molecule of poison such as ricin. A few milligrams of ricin can kill a human being, but when a molecule of it is linked to an antibody directed against T cells, it kills only those cells.

Chronic GVHD is generally treated with immunosuppressive drugs such as cyclosporine, steroids, and imuran, a medication also used in organ-rejection episodes. One advance has been the use of thalidomide, the tranquilizer infamous for causing birth defects in the 1950s. Although the mechanism of its action is not completely understood, thalidomide appears to have an immunosuppressant effect that moderates the symptoms of GVHD.

Interestingly, however, GVHD isn't always entirely bad news, at least for leukemia patients. Though the condition can frequently be deadly, it can also—for those fortunate enough not to succumb to it—improve survival. The reason is that part of GVHD consists of the Graft versus Leukemia effect (GVL), a phenomenon discovered in 1979 at the Fred Hutchinson Cancer Center in Seattle by physicians who noted that patients suffering more severe bouts of GVHD were less likely to have leukemic relapses. These physicians pointed out that if a transplanted immune system turns against a patient, causing GVHD, then some of that immune response is bound to be directed against the patient's leukemia. Studies are under way to tease apart GVL from GVHD, but for now GVL as a byproduct of GVHD is arguably the most widely used and successful form of immunotherapy available.



In the past decade, the number of people receiving donor marrow has risen substantially. Among them are (clockwise from top) presidential candidate Paul Tsongas, opera star José Carreras, and pop singer Julio Iglesias.

PHOTOS: BETTMANN ARCHIVE; CHART: ANNALS OF INTERNAL MEDICINE/DEBORAH PERUGI DESIGN

The Search for Donors

Another goal of BMT researchers is to expand the donor pool. So far, the most significant progress has come from the National Marrow Donor Program, which was created in 1986, and similar international donor programs. These programs actively seek people willing to donate marrow. The potential donors have blood drawn and tissue typed, and their tissue type is then entered into a computerized database. The donor registry not only maintains the database but coordinates any additional testing that may be necessary, as well as the eventual marrow harvest. Confidentiality of donor and recipient identities are protected to avoid any undue sense of obligation on either side; still, donor and recipient can exchange letters and gifts through the registry, as long as all references to location are censored.

An innovative way to expand the donor pool might be to routinely harvest newborns' umbilical cord blood, which is rich in the cell types able to develop into marrow.

Although the chance that any single individual will be a match for any other is very small, the international databases have a million names, mostly those of Caucasians, with the result that a Caucasian in need of a donor has about a 20 percent chance of finding one—Asians, African Americans, and Native Americans have less of a chance, because the proteins that need to be matched tend to vary among races. Also, since donors of all races are of course unrelated to the recipients, the risk of severe GVHD is 80 percent even if a match is found. But many patients are willing to take that risk, especially in cases where BMT may actually cure their disease.

A second option—BMT using blood collected from the placental and umbilical cord blood of newborns—was first reported in 1989 by Elaine Gluckman at the Hospital of Saint-Louis in Paris, and success with the process has been replicated by physicians at other medical centers. Such blood has been found to have a high concentration of the cell types that are able to develop marrow. One intriguing possibility might be to establish banks for umbilical cord blood harvested from the 4 million babies delivered in the United States each year. Those banks could greatly increase the quantity of donor marrow available, and thus the likelihood of finding a compatible donor for a patient in need. Furthermore, the bone marrow would be obtained without putting donors at risk from a marrow harvest.

The donor pool could be expanded still further by more frequently using a patient's own marrow as a source. This type of transplantation, called autologous BMT, is particularly useful when the sensitivity of marrow cells limits the types and doses of chemotherapy that can be delivered. Conventional chemotherapy works by killing rapidly growing cells, which include those of tumors, hair, and, unfortunately, bone marrow. If too much chemotherapy is administered, marrow is destroyed along with tumor cells, and the patient dies from a loss of marrow function—for instance, from a decreased ability to fight infection or stop bleeding. However, when marrow is removed prior to chemotherapy and reinfused afterward, higher doses can be given, and more people can be cured. Autologous BMT could be used to treat any solid tumor, but currently has shown its greatest promise in curing 20 percent of brain tumors that were once inevitably fatal. Preliminary studies suggest that it works slightly better than conventional chemotherapy for breast cancer, but at much higher cost.

The technique also helps in treating leukemia when no matched donor is available and the possibility of cure with conventional chemotherapy is small. Marrow to be reinfused is purged of leukemic cells in vitro, either by drugs toxic to them or by antibodies that bind to them.

But although autologous BMT overcomes the twin hurdles of donor availability and GVHD, it is generally less successful than matched-donor BMT for leukemia. One reason is that current purging methods use "negative selection"—the removal of unwanted cells—which is limited in its efficacy. Some cells can slip through, become reinfused, and cause relapse. Research now focuses not only on improving negative selection but on developing approaches for "positive selection"—that is, ways to select the marrow cell type that is the precursor of all others. The remainder of the marrow harvest could be discarded, and this cell type, which would generate the rest of the constituents of the marrow, could be reinfused.

Much of the research on positive selection has been conducted at Stanford University by Irving Weissman, who has found a possible precursor cell type known as the hematopoietic stem cell. This cell is estimated to turn up only once in every 10,000 marrow cells, and identifying it entails an electronic sorting process that analyzes the surface proteins on each cell. Tests to see if the sorted cells are indeed the precursors of all marrow cells are performed by giving primates marrow-killing doses of radiation and then reinfusing only the sorted cells. If full marrow function can be reconstituted, the selection process is considered to have been a success.

In the near future, autologous BMT with positive selection could drastically reduce the possibility of reinfusing malignant cells, thus improving survival for dis-

Bone Marrow Transplantation Step by Step

A BONE marrow harvest, which is usually performed under general anesthesia and takes one to two hours, entails repeatedly inserting a needle into the back of the hip and sucking up marrow from different sites in the pelvic bones, which are the safest and most easily accessible areas. The sites are accessed by angling the needle at varying trajectories into the bone, so that only two to three quarter-inch incisions have to be made on each side of the hip. The goal is to obtain roughly one to three pints of marrow—a quantity that represents less than 5 percent of the marrow in the body and is thought to have no long-term effects on marrow function. The donor is generally discharged from the hospital the following day, but may feel sore for one to two weeks afterward.

For the recipient, BMT preparation begins with admission to a room where the air is filtered to remove any bacteria or fungus, and where the air pressure is higher than in the adjoining hallway to ensure that infectious particles flow out, not in, when the door is opened. Prior to the transplant, the recipient receives intensive chemotherapy and/or radiation to suppress the immune system so it will not reject the new marrow. Such treatment also destroys any cancer cells that may remain, and makes space in the marrow cavity for donor cells.

The marrow transplant itself is a nonsurgical procedure analogous to a blood transfusion. The donor cells are infused intravenously into the bloodstream and circulate until a specific protein on the surface of each homes in on, and then binds to, a receptor protein on the surface of a supporting cell in the recipient's marrow space. Once inside the marrow space, they mature and divide.

For the two to four weeks before the transplanted marrow begins to function adequately, the patient is dependent on blood and platelet transfusions. White blood cells, which defend against infection, are also not being produced, but unfortunately, there is no practical way to transfuse them, so powerful antibiotics are administered. Sometimes, however, the antibiotics are not enough and the patient dies of overwhelming infection.

In recent years, substances such as G-CSF and GM-CSF—granulocyte colony stimulating factor and granulocyte-macrophage colony stimulating factor, respectively—have decreased the time needed for marrow recovery by approximately one week. This smaller window of vulnerability has shortened hospital stays, lessened the need for antibiotics, and reduced the potential for fatal infections. G- and GM-CSF, together with similar substances now being tested, are naturally occurring proteins produced in large amounts through advances in genetic engineering. In the case of G- and GM-CSF, genes for them are removed from human cells and inserted into bacterial or yeast cells that then constantly produce the substances as part of their growth cycle.

But even after the transplanted marrow can support red and white cell production, the recipient is still at risk of developing serious and sometimes fatal infections. This is because recovery of the immune system's full function proceeds at a slow pace, which is attributed to the complex interactions that must take place between donor and host cells as the marrow adapts to its new environment. Thus for a period of six months to two years, the discharged patient continues to take antibiotics and anti-viral medications and receive intravenous infusions of gamma globulin, a substance that consists of antibodies. ■

—Ronald Kline

eases such as leukemia. Yet even if malignant cells could be screened out completely, autologous BMT as it exists now would be less than ideal for treating leukemia, since a reinfusion of a patient's own marrow causes no GVHD—and hence no GVL. One particularly innovative idea, pioneered by Alan Hess at Johns Hopkins University in Baltimore, is to create a mild form of GVHD, just enough to gain the benefits of GVL. That could be accomplished in autologous BMT by administering and then suddenly discontinuing the immunosuppressant drug cyclosporine, instead of tapering it off as is usually done. In tests, this technique has resulted in the prolonged survival of animals with leukemia. Preliminary studies in human patients have shown that it improves survival for lymphoma.

Although current applications of autologous BMT cannot treat diseases such as sickle cell anemia that are caused by inherited defects in the marrow, advances in genetic engineering will someday make it possible to remove marrow from a person with one of those diseases, insert a crucial gene in vitro, eliminate the defective marrow with chemotherapy, and then reinfuse the corrected cells. This would constitute a cure that does not depend on the availability of donors and carries no risk of GVHD. Further in the future, autologous BMT may be used to give some patients cells that overproduce a certain substance, like an enzyme that metabolizes cholesterol. These superfunctioning marrow cells could compensate for defects in non-marrow cells.

One of the main challenges for both of these applica-

tions is that the technology to insert a gene into cells of the relevant type has yet to be perfected. Also, even when researchers can manage to insert the gene anyway, it often fails to function well, especially over long periods of time. However, in May of this year physicians at the University of California at San Francisco and Children's Hospital of Los Angeles did attempt to use this sort of gene therapy to treat an infant diagnosed in utero with an enzyme disorder that causes immunodeficiency. They inserted the necessary gene into cells they had harvested from the child's umbilical cord blood. But it's still too early to tell if the strategy was successful.

The ethics of who should be allowed to donate marrow can be complex. In one controversial case, a California woman (right) conceived a child in the hope that its marrow would be a match for her leukemic daughter (left).

Confronting Ethical Dilemmas

Far-reaching as such procedures may be, the future of BMT will be decided not just in the hospitals and labs but in the courts, government agencies, and insurance companies. For example, consider the potential ethical quandaries that surround who should be allowed—or forced—to donate bone marrow.

The problems have already begun. In one instance, the Illinois supreme court rejected a request from a father that the two half-siblings of his leukemic son be tested as possible donors. The court ruled that despite the minimal risk to the donor and the possibility of saving the boy's life, the half-siblings could not be forced to donate marrow, or even be tested to see if they were compatible donors. In another instance, a California couple conceived a child in the hope that it would be a match for their leukemic daughter. The infant was in fact a match and the marrow donation, which turned out to be successful, was allowed to proceed. The situation illustrates the uniqueness of marrow donation: after all, no court would have condoned the conception of a child in order to serve as a kidney, liver, or heart donor. Because marrow constantly replenishes itself, the ethics of donation are more muddled.

Also, the couple in question stated that they would love and keep the child whether or not it was a suitable donor, but one can imagine a scenario in which a couple attempts multiple pregnancies, aborting successive fetuses that are not a match for their sick child. The ability to test for transplantation proteins as early as six weeks of gestation makes this a real possibility. Such a scenario might severely test the American people's uncomfortable acceptance of abortion rights.

Another ethical issue of BMT is who should be allowed to undergo the procedure. The average cost of $150,000 and the rigors of transplantation, including a hospital stay that averages two months, argue for exercising some discretion. BMT is often performed in cases where there is no alternative treatment, or where the alternative is clearly inferior. Yet even these seemingly unambiguous criteria tend to break down. In diseases such as sickle cell anemia and thalassemia, both of which are inherited defects in hemoglobin synthesis that result in severe anemia, an alternative treatment is indeed available, namely blood transfusions. However, that treatment carries its own considerable risks.

Besides the well-known dangers of transmitting HIV and the hepatitis viruses, blood transfusions over a period of several decades can result in an iron overload, which can lead to heart and liver failure. Although better drugs to treat and prevent such overload are being developed, it remains a threat for now. On the other hand, BMT performed on children, for whom the risk of the procedure is lowest, can cure thalassemia, sickle cell anemia, and similar diseases 90 percent of the time. Of the 10 percent of patients who are not cured, half will just be back where they started from: their own marrow will recover and displace the transplanted cells. But to make the matter of whether to perform BMT even more complicated, the other half will die from the transplant. The procedure provides long-term cures for many at the cost of early death for a few.

Extending BMT to sicker patients, or to patients with less than perfectly matched donors, also increases short-term mortality for diseases like sickle cell anemia and thalassemia while curing most who would otherwise die in the long term—that is, over 15 to 30 years. The same question arises of where to draw the line, how many short-term deaths to accept as the price for more cures.

For other diseases, the prospects of long-term survival with BMT range from 90 percent all the way down to 10 percent. Many patients will understandably grasp at any chance for survival, no matter how small. Should a minimal success rate be required before an expensive and arduous BMT can be performed? And who should make the decision? Physicians, as well as the insurance

PHOTO: BETTMANN ARCHIVE

companies and government agencies responsible for funding most of the transplants in the United States, are grappling with that issue.

Most health insurance policies provide coverage based on the present "standard of care" and exclude coverage for "investigational treatments." Yet the policies also provide for the "best available treatment," and the truth is that the best available treatment may not be what the insurance industry currently defines as the standard of care. It may be an experimental BMT simply because no other effective treatment is available. In such cases, BMT may have shown promise with a related disease. Or it may have been successfully used to treat the patient's disease in a few experimental instances.

Finally, personal responsibility plays a role in the ethics of funding BMT. For example, suppose that a couple, unbeknownst to them, carries a genetic trait making their children, or a high percentage of them, vulnerable to a disease cured only by BMT. While few would dispute the merits of treating the first afflicted child, some might argue that such a couple has a responsibility to avoid conceiving other children, since they might consume a vast amount of medical resources. Should certain couples be limited in how many children they can have, or in how many are entitled to a government- or insurance-sponsored transplant? And again, who should decide?

BMT is typical of the expensive, high-tech procedures that have come to play such an important role in health care over the past several decades. And like all such procedures, it is forcing society to face a host of new and difficult issues. We need to decide which risks and trade-offs are ethically acceptable, and balance the desire to save lives against the need to deal with the mounting economic constraints in our medical system. ■

Video Games

My son Lincoln, 8, sits in front of the TV in universally recognized video game posture: back slightly hunched, baseball cap on backward, thumbs placed lightly on the controls. We pop in the cartridge for a new game, and he starts to play. He deftly manipulates the screen cartoon with the finesse and concentration of a pilot who's logged hundreds of hours at the controls.

When I told Lincoln that I was going to be bringing home some new video games and computer programs, he reacted as if he'd been given a thousand new baseball cards. He had explored the Nintendo world of Super Mario and its mazes and castles and dragons and flagpoles and coins, and he was eager to try out something new; it didn't much matter to him that someone was calling the stuff "educational." So when I produced a game called "Mario Is Missing," from Software Toolworks, he and his brother practically ripped the box apart to get

Children assimilate information
Although much of this gain

ILLUSTRATIONS BY
DIANE BIGDA

That Teach?

BY HERB BRODY

and acquire skills with astonishing speed when playing video games.
is of dubious value, the phenomenon suggests a potent medium
for learning more practical things.

to the cartridge and pop it into the game machine.

In "Mario Is Missing," the hero's brother, Luigi, wanders around various locales in search of Mario, who has been kidnapped. To figure out which city Mario is in, the player has to not only dodge the usual array of video-game obstacles—killer turtles and the like—but also answer some simple geography questions presented by passersby. Gather enough hints and you're able to zap yourself into the city to which Mario has been kidnapped. The game typifies the blend of education and entertainment—and, unfortunately, its limitations so far—as video games increasingly strive to instruct and learning software attempts to amuse.

The Worst of Both Worlds

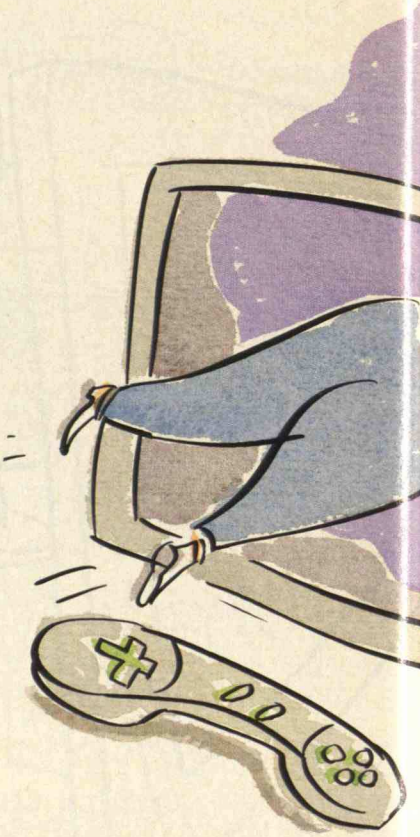
When a family buys a video-game system, tensions rise. The kids have a ball. But the parents worry that they are spending far too much time on something so frivolous and frighteningly addictive. Parents want their children to have fun, but wish there would be some intellectual nourishment along the way. The realization that this parental desire reflects a substantial additional market is nudging entertainment companies into the foreign realms of education, especially to persuade parents to buy into a new generation of games.

Thus the very companies that have been feeding children's insatiable desire for video games are now beginning to develop products that look and feel like games but that actually teach the player something of more lasting value than the hand-eye skill of evading attackers or capturing a prize. Cartridges for the game machines that plug into televisions (Nintendo and Sega) now include titles like "Mario Is Missing" and a similar, history-teaching game called "Mario In Time" that purport to instruct as well as entertain. At the same time, makers of educational software for computers are attempting to distill whatever it is that makes video games so captivating and apply it to their unabashedly scholastic products.

But so far, the marriage of education and video-game-like entertainment has produced some not-very-educational games and some not-very-entertaining learning activities. Technological developments—such as the advent of inexpensive CD-ROM players, and major leaps in the ability to encode video signals in a "compressed," or abbreviated, form—could help because they allow far greater volumes of information to be presented in game-like formats. But these technologies will result in a more satisfying crop of products only if the two cultures that dominate our children's lives—education and entertainment—do a better job of figuring out what the other has to offer. In particular, it remains for someone to isolate whatever it is that makes video games so captivating and use that magic motivational ingredient to help kids learn in any substantial way.

The underwhelming nature of these products is in part a reflection of the modest amount of attention that the entertainment industry has paid to a genre whose market potential is, at best, uncertain. Until recently, game companies tended to view the demand for educational content the way lawyers see pro bono work: good for the corporate image if not the immediate bottom line. "No one has proven that a market exists for a home machine for educational multimedia," says Martin Levine, editor of the newsletter *Digital Technology Report*. Thus entertainment companies have seen little financial motivation to devote serious resources to educational games.

As companies blend educational content with action and adventure, video games could shed their image as frivolous time-wasters.



But the landscape is changing. "The market is saturated" with games that run with existing technology, says Susan Harmon, managing director of educational entertainment market research at the New York-based investment banking firm of Robertson, Stephens, & Co. In the next year or two, a new generation of game machines will emerge. These systems will employ computing chips able to process data in chunks of 32 bits, as opposed to the 16 bits of the Super Nintendo and the Sega Genesis systems and the 8 bits of the original Nintendo. The higher the bit number the greater the screen resolution, the more varied the palette of colors,

Herb Brody is a senior editor of Technology Review.

and the more complex and multileveled the games. But how will parents be persuaded to plunk down another $200 to $300 for a 32-bit machine plus another hefty wad of money for the new game cartridges that will exploit the 32-bit technology? Assuming that adults will balk at paying for another purely game-playing toy, the game industry is striving to establish its products as learning tools—which, Harmon says, will make them more "socially acceptable and parent accessible."

Schools represent another potential market for learning games. For many schools, Harmon says, it makes

more sense to pay $300 or less for a 32-bit game machine than to pay $1,500 for a personal computer with a CD-ROM attachment. And as Nintendo and other game companies continue to blend educational content with action and adventure, game systems could shed their stigma of frivolous time-wasters. In the end, "these products will sell themselves" to teachers, says Sharon Bell, director of educational technology for the New Orleans public schools. "When teachers see a kid's face glowing with the love of learning, or having a eureka experience, they become believers."

The Lure of Video Games

The central notion driving the new marriage is that games provide an environment in which people—and children in particular—are more receptive to learning. Successful completion of a few levels of "Super Mario Brothers" requires the player to become intimately acquainted with an alien landscape, with characters, artifacts, and rules completely foreign to ordinary existence. (There aren't many castles or killer turtles or friendly dinosaurs in twentieth-century America, and eating mushrooms doesn't generally make you grow larger.) Children assimilate this essentially useless information with astonishing speed. Within two weeks after a Nintendo system arrives at our house, both my school-age sons travel with ease through the multilayered realm of the Mario games, racking up points and "warping" to other worlds at will.

But no one really understands what it is about video games that proves so motivational. The best guess is that children relish being in control of what's on the screen. In a museum, the most popular exhibits are the ones that are "interactive"—they let you push buttons and watch things happen. Video games offer this control on a continuing basis. Also, video games give kids a powerful sense of mastery. Success is addictive, and video games provide constant doses of small successes as players defeat more enemies, earn higher scores, and graduate to more challenging levels.

Standard explanations of what makes video games such effective teachers would also seem to imply that children should learn well in traditional home and school settings, assuming the presence of minimally competent teachers and parents. There's nothing more interactive than a conversation with another person, live and in the flesh. And do the vaunted "control" and "mastery" that children enjoy while evading danger and seeking treasures on the screen significantly surpass the satisfaction of exploring a book—turning pages backward or forward, and at one's own pace?

Some characteristics do set video games apart. Children, at least of the present generation, enjoy the special thrill of achieving a level of skill that their parents generally can't match. The element of fantasy comes into play too; video-game characters inhabit bizarre worlds and possess extraordinary capabilities, triggering fantasies in children who seek heroes to identify with. Then there is the undeniable rush of adrenaline—nothing focuses the mind like fear of imminent "death." Even when the player knows that it's all artificial, the sweaty palms and glazed eyes suggest a survival instinct flipped into high gear.

In some cases, games inject excitement into otherwise dreary learning tasks. In "Mavis Beacon Teaches Typing," from Software Toolworks, for example, one of the exercises puts the student in a car race. The faster and more accurately you type a selection that scrolls across the screen, the faster your car goes. It's a tense activity, as is any timed test, but the appearance of direct competition at least makes the tension more gratifying.

And since typing is a rote mechanical skill anyway, kids welcome any activity that turns it into a game.

Despite the stereotype of games as solitary activities, part of their appeal lies in the collaboration that they foster. Kids talk about game strategies in school, and when they visit each other's houses they gleefully share tricks. In my house, some of the most intense conversations occur around the Nintendo game as onlookers urge a player onward using some new strategy, sometimes mined from a manual but often passed on word-of-mouth from another friend. This ability to articulate a complex strategy is a very high-level skill in and of itself, says Mitchell Resnick, a professor at the MIT Media Laboratory.

Experts on learning emphasize that the secret to education is to motivate the student—give him or her a compelling reason to want to absorb the information. In a good game, players lust after high scores and, more fundamentally, staying "alive." Adventure games also motivate the player by indulging the urge to explore: "If you succeed, you get to go somewhere new," explains Michael Knox, president of Park Place Productions, which makes video-game and computer software. "It's like putting a carrot on a mule cart, or sugar on a vitamin." And the exploration carries no substantial risk: game designers let players "die" many times before ending the session. No wonder my son Lincoln stays so serene as he plays these games that give me sweaty palms just to watch: he has grasped the transitory nature of electronic demise. "Look, dad," he says, as he maneuvers Mario through a treacherous videoscape: "I just got 19 bonus lives."

Unfortunately, in most of the programs that purport to instruct, this powerful and innate quality is replaced by artificial lures, such as words of praise or dancing cartoons. But children are not seals, and although crude bribery might entice them to try something, the only thing that will keep them at it, and that will open their minds to new knowledge, is a conviction that learning will do them some good, right now.

Looks Great—Less Filling

Video games have become synonymous with eye-popping graphics. Screens burst with color, and well-rendered characters move amusingly through dazzling scenery. Unfortunately, this heritage weighs down the development of programs that attempt to combine entertainment with education. By relying so heavily on visuals, educational software is forced to compromise: data capacity that is used to enhance a graphical display or provide animation is not available to convey more substantive information. Even a 600-megabyte CD-ROM has a finite amount of digital "real estate"—and pictures, especially motion video, occupy huge expanses.

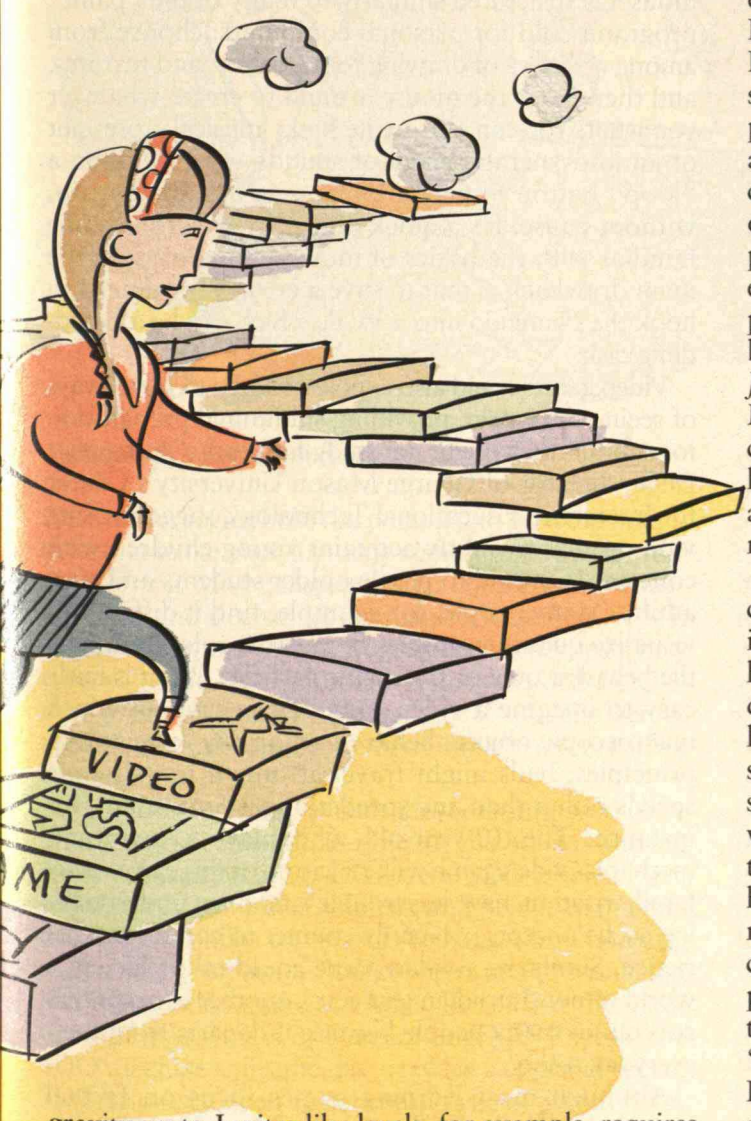
For example, a multimedia extravaganza from Software Toolworks called "San Diego Zoo Presents the Animals" offers still pictures, audio segments, and brief video clips of dozens of animals. But because it devotes so much memory to images, the program offers text that is disappointingly superficial. A typical entry would occupy only a fraction of a page in a printed encyclopedia. Such graphics-intensive software also puts heavy demands on the hardware. This doesn't matter so much for video-game systems—those self-contained units that plug into the television. But if you have a home computer, you'll despair at the amount of hard-disk space and memory that some of the new programs require. Each of several learning games from Electronic Arts, such as "Cuckoo Zoo" and "Scooter's Magic Castle," requires a full 15 megabytes on the hard drive—an expanse of digital territory that few home computer users can spare. Some programs also hog huge amounts of a computers' internal memory. To run some educational software on my office Macintosh, I had to disable a number of programs that usually start up automatically with the machine. The need to make such adjustments detracts from the value of these products. A wonderful program does no one any good if its gargantuan size keeps it on the shelf.

Video games captivate players—and compel them to learn—by continually doling out small doses of success.

Besides, the idea that state-of-the-art graphics are essential to harnessing video games for educational purposes does not stand up to closer examination. Even the most sophisticated computer graphics fall short of the resolution and clarity of television and movie images, but they still mesmerize children anyway. And kids learn from well-designed games even if the graphics are crude.

For example, Lincoln and his older brother, Dustin, have been playing a game called "Gorilla" that comes packaged with the PC programming language QBasic, and they have developed keen senses of angles and trajectories. In this game, each player controls a cartoon gorilla that stands, King Kong-like, atop a skyscraper in a scene that is visually so crude it could have been

drawn on an Etch A Sketch. The gorillas take turns throwing an exploding banana at each other. For each hurl, the player must type in an angle of launch and a speed—choose the right trajectory and you get the thrill of obliterating your opponent; choose wrong and your banana crashes into a building or sails off the screen and you run the risk of being obliterated yourself on your opponent's next turn. In setting up each game, you can also adjust gravity to any arbitrary strength: turning



gravity up to Jupiter-like levels, for example, requires you to heave the banana much faster and at a much steeper angle to reach its target—effectively illustrating principles of physics and geometry.

Both boys quickly got good enough to blow up their father, despite my book learning in physics and mathematics. The gorilla game illustrates perfectly how games can force players to acquire a kind of knowledge that they would have no use for otherwise. And to my surprise, the knowledge has stuck: Lincoln now knows a 45-degree angle from a 60-degree one—a subject area as yet untouched by his third-grade formal education. He learned because knowledge of angles became essential to his ultimate goal of defeating his opponent; the low-tech graphics seemed not a factor.

Gimmicks and Contrived Hurdles

Such successes, however, are still the exception. The rush toward interactive learning software has created a flock of products whose educational edge over more conventional media is difficult to discern, or where the educational content is an odd fit. Take, for example, Brøderbund's fast-selling and critically praised Living Books—CD-ROMs that play back illustrated children's stories with animation and cute twists. Each computer page is "alive." Characters move and talk, and almost anywhere in the scene, something happens when you click a mouse: a character speaks a line of dialogue, an object moves, a displayed word is pronounced. A preschooler can easily spend five minutes or so without ever having the urge to turn the page at all. The first product in the Living Books series seems to work mainly because of the charm of the book on which it is based—*Just Grandma and Me*, by popular children's author Mercer Mayer. It has no "lesson" per se, unless you count the activity of clicking on a word of the text and hearing it pronounced. It is simply a story, and offers all the richness of language and imagery that come from reading any good picture book.

In too many cases, says the Media Lab's Resnick, educational games impose lessons as artificial hurdles: Life is presented as a series of clues and puzzles, all of which have correct answers. Recite a fact, or answer a quiz question, and the player gets to move on to the next level. Many of the more popular knowledge games, such as Brøderbund's "Carmen Sandiego" series, present history and geography as pop-quiz topics. A player who knows the Eiffel Tower is in France may capture the gangsters more quickly, but this factoid otherwise has nothing to do with the game; it is a contrived barrier. Similarly, the designers of "Mario Is Missing" basically took a popular game and slapped on a few trivial pieces of geography. Sample clues: Melbourne, Australia, is "a city in the land down under;" New York is a "city with the same name as its state." "Castle of Dr. Brain," a program from Sierra On-Line, teaches math and science in an arcade-game like setting. The player wanders through various rooms, each containing a puzzle of some kind that must be solved if the adventure is to continue. To get out of one room the player has to write a simple computer program that instructs a robot to open the door; another room can be exited only by adding numbers in binary (*see also "Science Class Was Never Like This," page 74*).

In such games, the learning of factual information becomes important in the same way that it would if highway toll takers made everyone perform an arithmetic problem or recite a line of Shakespeare before being permitted to continue driving. No such mismatch

with reality hampers progress—or pleasure—in a "pure" video game, where the knowledge acquired is part of the fantasy, not tacked on.

Indeed, much of the new learning software takes only the most superficial lessons from the video-game world. Where educational software seeks to buttress the child's self-esteem, as in video games, it does so in a much less satisfying way. In a program from Brightstar called "Ready Set Read," a cartoon chimpanzee and jack-in-the-box praise the child lavishly in a synthetic voice for every minor accomplishment. "You're smart," chirps the monkey when the player correctly guesses which of three words rhymes with "king." "Way to go!" says the jack-in-the-box after you drag a word from a list into its correct position in a sentence. But children gain far greater pride from advancing through the mazes and castles of "Super Mario Brothers" without ever being told that they are "smart." True pride comes from accomplishment, not from preprogrammed praise.

New Ways of Learning

Pedagogically, children will learn more if the acquisition of knowledge is made integral to the game, says Resnick. Some of the best educational software takes this advice to heart. In a series of programs from Maxis, including "SimCity," "SimLife," "SimAnt," and "A-Train," the player not only explores but also creates a new world and the Sim software seamlessly integrates learning with the game. Understanding of basic genetics is crucial to creation of a successful life form in "SimLife," for example, and in "SimCity" and "A-Train," the player must quickly learn the basics of economic development and urban planning. "SimAnt" portrays the dynamics of an ant colony, showing how it responds to variables such as changes in food supply, presence of predators, and proximity of anthills to one another.

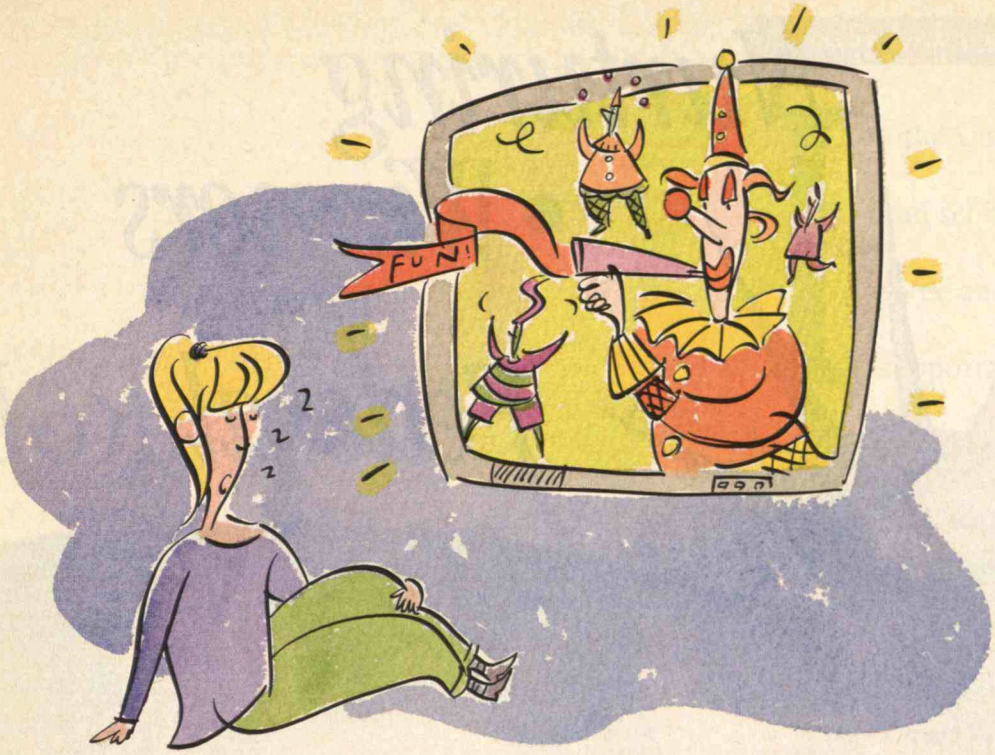
Despite their packaging as "games," the Sim programs lack a video game's holding power. For one thing, the software is too complicated. The screen is full of "buttons" and controls and option menus. This is necessary to make more realistic scenarios—in "SimLife," for instance, you can populate your world with any of dozens of different plant and animal species. But this complexity also makes it difficult to get anything out of the program with the kind of random noodling around that characterizes the way most kids approach video games. You can't just sit down at the computer, play with the menus, and see what happens.

Still, for those with the patience to learn them, the Sim products outclass most of the programs and games that pass themselves off as educational. Players learn not only about the specific subject at hand—the habits of ants, say, or planetary ecology—but they also become immersed in the dynamics of systems. With their vivid demonstrations of the widespread and subtle effects that ensue from changes in different variables—an atmosphere's concentration of carbon dioxide, say, or an organism's life expectancy—the Sim products give kids practice in a crucial kind of thinking that schools don't sufficiently provide.

Computers and video games can educate in an even broader sense. One of the most popular games for the Nintendo game system, "Mario Paint," turns the television set into a palette for the creation of a dazzling array of visual art. The product, which includes a mouse, is structured similarly to many of the "paint" programs sold for personal computers: choose from among a variety of drawing tools, colors, and textures, and then move the mouse around to create whatever you want. You can also create funky musical scores out of an idiosyncratic array of sounds—and click on a "loop" button to play it back, over and over again, without pause. It's a quick-and-dirty way to become familiar with the basics of musical composition; the main drawback is that to save a creation you need to hook the Nintendo into a VCR, which can be a befuddling task.

Video games could also expose children to novel ways of seeing the world, providing subliminal preparation for subjects they might not study for years. Christopher Dede, director of George Mason University's Center for Interactive Educational Technology, suggests using video games to subtly acquaint young children with concepts that tend to perplex older students and even adults. Many people, for example, find it difficult to visualize quantum physics because its rules dominate the behavior only of subatomic particles. But it is fairly easy to imagine a video game, Dede says, in which macroscopic objects behaved according to quantum principles; balls might travel at only a few discrete speeds rather than any speed along a continuum, for instance. The 10-year-old who plays a quantum-mechanics video game will, by virtue of this early visual familiarization, have less trouble later on in understanding such concepts, which fly counter to common experience. Similarly, a video game could take place in a world of non-Euclidian geometry, another concept that confounds many people because it departs from their everyday reality.

Although most learning games focus on factual knowledge, skills development, and problem-solving strategies, computers also offer a medium for teaching more subjective concepts. The ability to store large amounts of video would make possible programming that allows a player to view a drama from many different points of view, suggests Knox of Park Place Productions. "We could let kids go through a day in the life of a black person in the old South," he says. Kids could electronically "experience" the reaction to the person's attempt to use segregated facilities, for example, or to register to vote. The player could then return to the beginning and play through the same events from a white person's point of view.



Much of the new learning software takes only the most superficial lessons from the world of video games.

Technology's Semi-Solutions

New technologies hold the potential to ease the limitations that make many of today's educational products so unsatisfying. Most conspicuously, a consortium of entertainment and electronics companies, including AT&T, Time Warner, and Japan's Matsushita has devised a new type of home entertainment system—called 3DO—that promises enough technological horsepower to provide both the sizzle of entertainment and the steak of education.

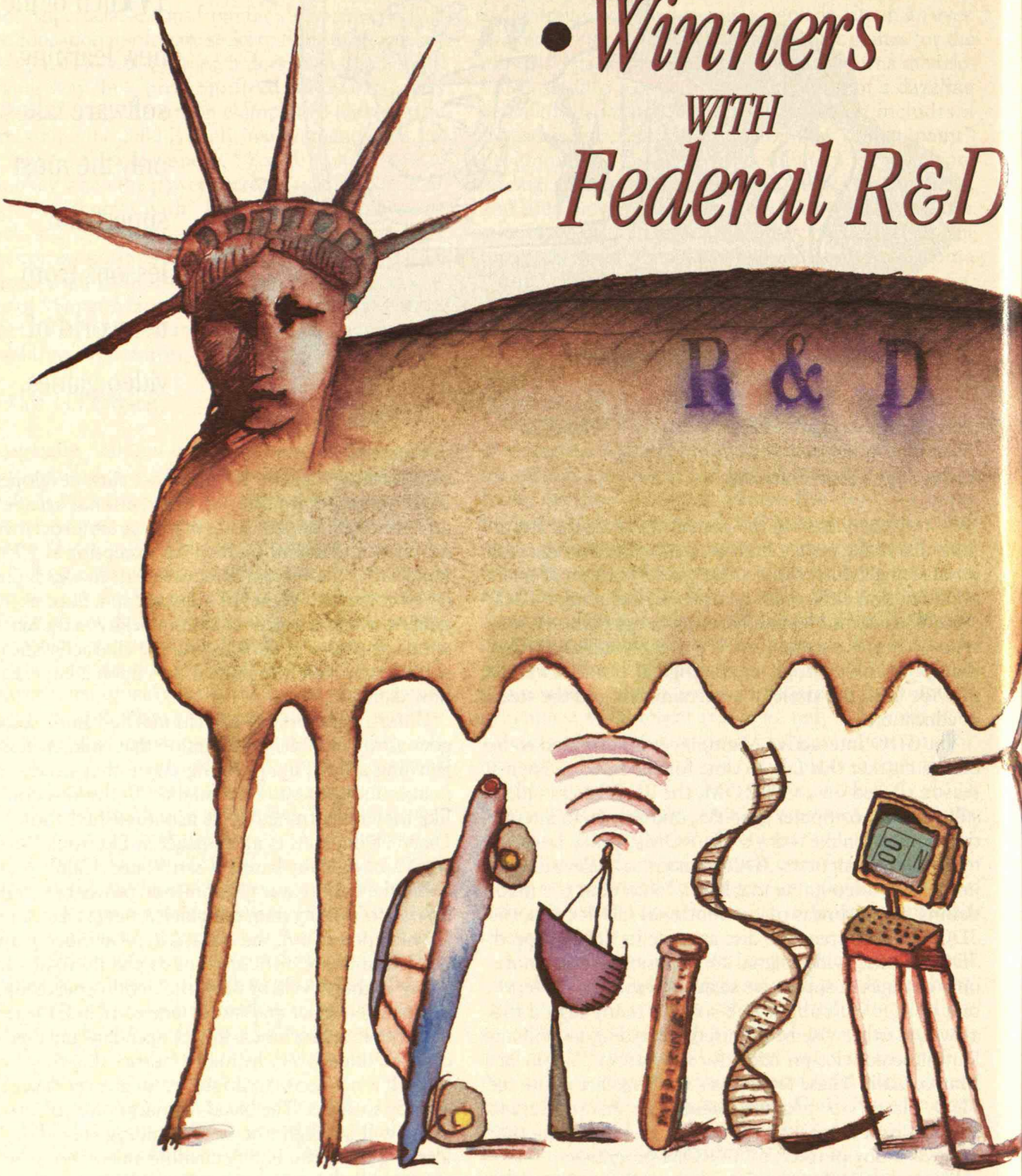
The 3DO Interactive Multiplayer is supposed to be on the market this fall, in time for the holiday buying season. Based on a CD-ROM, the 3DO offers video, still pictures, computer graphics, and text in an interactive format. Unlike today's CD-ROMs, which hook up to personal computers, 3DO connects to a television set, just like a video-game machine. To combat the maddening sluggishness of conventional CD-ROMs, the 3DO machine spins the disc at twice its normal speed. 3DO also uses video signal compression—which notes only changes in successive scans of a screen—to represent images with about one-sixth as many digital bits as would otherwise be required, according to William Duvall, senior vice-president for software at 3DO in San Mateo, Calif. These techniques will together allow the 3DO player to provide seemingly instant screen changes, in contrast to the 10- to 15-second lag that bedevils many of today's CD-ROM programs.

While the 3DO system has obvious virtues as an educational tool, that's not where it is headed, at least not right away. Of the dozen or so titles that will be released with the system's introduction this fall, few have significant learning content. For the most part, developers of 3DO software are offering conventional arcade and adventure games, boasting mainly an improvement in graphics and sound quality. An exception is "Worldbuilders," a game from Electronic Arts in which players try to colonize a planet of a distant star. Success in this game—which is similar in its complexity to the Sim software—requires understanding the characteristics of a solar system, and the game draws upon a large astronomy database.

Unfortunately, much educational and game software goes astray with the presumption that children consider learning a dull, unappealing chore that needs flashy images and games to be palatable. "If the kids don't feel like they're learning, we've accomplished a lot," says Diane Flynn, marketing manager at Electronic Arts, the software company based in San Mateo, Calif.

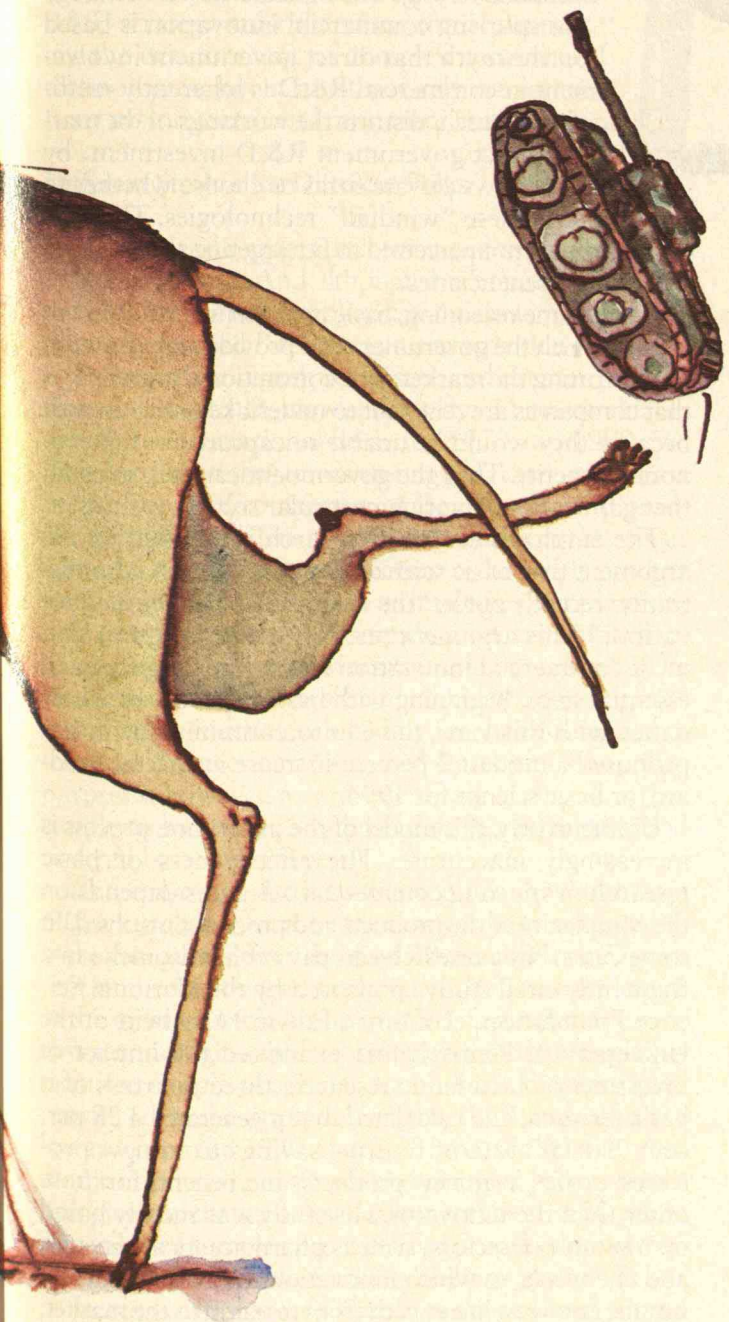
But the video-game phenomenon proves that children do not necessarily shun difficult learning tasks. After all, Resnick points out, the reward in most video games is not to eliminate difficulty but to pile it on; at successively higher levels of play, the action speeds up, the enemies get cagier and more numerous, and the terrain becomes more tortuous. In fact, spending any time with children offers overwhelming evidence that they love to learn. It is not necessary to sugarcoat an experience that's already so sweet. The blend of education and entertainment will succeed not by pretending that there's no learning going on, but by creating an environment that feeds children's natural curiosity, rewarding them not with mechanized praise or visual candy but with real knowledge and the chance to learn even more—in other words, with power. ■

Nurturing • Winners WITH Federal R&D



DIRECT GOVERNMENT INVESTMENT IN VALUABLE COMMERCIAL TECHNOLOGIES MUST REPLACE OUR RANDOM, INEFFICIENT, AND OBSOLETE R&D SYSTEM BASED ON MILITARY SPINOFF AND BASIC RESEARCH.

BY DON E. KASH AND ROBERT W. RYCROFT



IF the United States government had set out to design a cumbersome and ineffective system for supporting commercial technological innovation, the result would look very much like what we have today. For decades, government research and development programs have aimed mostly to assist basic research and promote the efforts of specific "mission agencies"—primarily those involved in defense, space, energy, and health. ❖ Though such a strategy may sometimes advance commercial possibilities, it does so randomly and at great cost. Because the United States cannot afford to take such a circuitous path when its international competitors are using the direct route, there is growing support today for the use of federal funds to promote commercially oriented R&D. The challenge, however, is to design a federal strategy that

ILLUSTRATIONS BY BLAIR THORNLEY

COMPLEX PRODUCTS SUCH AS AUTOMOBILES SUCCEED PRIMARILY THROUGH CONTINUOUS, INCREMENTAL IMPROVEMENTS.

successfully promotes innovation in the most valuable technologies and products.

Innovation occurs differently in different industries. In some, investment in basic R&D is sufficient to spur innovation. In others, innovation is based on the subtle refinement of processes and products, and therefore requires investment in applied R&D. The federal government's ability to promote commercially successful innovation depends on its ability to discern the difference and act accordingly. And that means first combatting the myths that have shaped federal R&D policy since World War II.

Abandoning an Outdated Approach

The post-World War II emphasis on mission-oriented R&D and basic research became even more pronounced during the 1980s and early 1990s, based on the deeply ingrained assumption that commercially valuable spinoffs would automatically flow from this kind of investment. The spinoff argument rests on the premise that technologies such as those developed for the military can often be adapted for commercial purposes. Indeed, just after World War II, the volume and diversity of Pentagon R&D spending spurred commercial innovations in a variety of industrial sectors, including technologies such as semiconductors, computers, jet aircraft, and communications satellites.

In recent years, however, defense spinoffs have become fewer and less important. In *Beyond Spinoff*, the most comprehensive analysis of the subject, John Alic and his colleagues at Harvard's Kennedy School of Government cite two key factors responsible for this trend. First, military and civilian technology development have diverged. Many defense systems have become so specialized that they have no application to civilian use, while export controls and classification have also slowed the diffusion of technological innovations. Secondly, in many sectors of the economy the pace of technological innovation in civilian firms has outstripped that of defense labs and contractors. In fact, the Pentagon itself has become dependent on commercial technology, giving rise to the term "reverse spinoff."

Other mission-oriented projects, such as those sponsored by the National Aeronautics and Space Administration, have also failed to generate significant commercial spinoffs. Only communications satellites are considered a major success stemming from space R&D. A recent in-house NASA analysis concluded that the agency had not achieved many spinoff successes lately, and that evidence of past successes was "largely anecdotal."

Nonetheless, ideological opposition to direct federal investment in commercial R&D remains strong. The "trickle-down" strategy for spurring commercial innovation is based on the myth that direct government involvement in commercial R&D is inherently inefficient because it distorts the workings of the market. Indirect government R&D investment, by contrast, allows private firms to choose whether to use or ignore these "windfall" technologies. Thus the government is not perceived to be targeting technologies or selecting beneficiaries.

By the same reasoning, basic research is considered an area in which the government can provide support without distorting the market. The conventional argument is that companies are reluctant to undertake basic research because they would be unable to capture the full economic benefits. Thus the government can step in to fill that gap without favoring particular sectors or firms.

The emphasis on basic research is justified by the argument that basic science is, as the Clinton administration recently put it, "the wellspring of technical innovation." This argument rests on the assumption that most commercial innovation involves a long series of essential steps, beginning with basic research. In accordance with this view, the Clinton administration has proposed a modest 2 percent increase in federal funding for basic science for 1994.

Unfortunately, this model of the innovation process is increasingly inaccurate. The effectiveness of basic research in spurring commercial advances depends on the complexity of the products and processes involved. In some cases, basic research can pay off handsomely: In a frequently cited study sponsored by the National Science Foundation, economist Edwin Mansfield of the University of Pennsylvania examined the impact of investment in academic research, three-quarters of it basic research, and calculated that it generated a 28 percent "social" rate of return—savings from new processes, profits from new products, and benefits for those other than the innovator. His study was mostly based on a sample of sectors, such as pharmaceuticals, metals, and chemicals, in which innovation follows a relatively simple, one-way, linear path from research to the market.

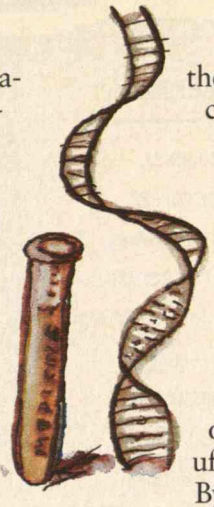
However, innovation in complex products such as automobiles and consumer electronics relies little on fundamental knowledge. Instead, these products succeed primarily through continuous, incremental

DON E. KASH holds the Hazel chair of public policy at George Mason University's Institute of Public Policy. ROBERT W. RYCROFT is program director of the Center for International Science and Technology Policy at George Washington University. The authors expand on this article in their forthcoming book, Technology Policy in a Complex World.

THE GOAL OF RATIONALIZING U.S. R&D POLICY, HOWEVER, CANNOT BE ACHIEVED INCREMENTALLY.

improvements. Innovators must draw on information gained from design, development, manufacturing, services, and marketing as well as from basic research.

In the global marketplace, complex technologies are becoming increasingly critical. They already account for perhaps three-fourths of the value of technological trade. A successful R&D strategy must therefore aim at supporting the development of complex commercial technologies, but it must not rely on spinoffs from basic research and mission-oriented projects.



Different Strokes for Different Folks

Clearly, federal support of commercial technologies has to be more direct. And although it is popular to ridicule the notion that public policy can "pick winners," commercially focused R&D requires exactly that.

To begin the search for faster and greater payoffs from federal R&D, we identified the 30 most valuable sectors in international trade for 1970 and 1990. We then distributed the sectors among four categories based on the degree of complexity of their process and product technologies. The result is two matrices (*see pages 62 and 63*), each composed of four cells: simple product technologies/simple process technologies, simple products/complex processes, complex products/simple processes, and complex products/complex processes. (The distinction between simple and complex technologies is based on an index developed by Stephen Kline, a professor of engineering at Stanford University. For policy purposes, however, a convenient rule of thumb is that simple technologies are those that can be understood in detail by a single expert.)

As the matrices and a further analysis show (*see page 64*), a number of significant changes have occurred in these categories over the past 20 years. First, 27 percent of the most valuable sectors in 1970 are no longer in the most valuable group in 1990. Second, many process technologies are becoming ever more complex—even for simple products. A number of sectors have moved from the upper left of the 1970 matrix to the lower left of the 1990 matrix. Third, the relative economic importance of simple and complex product technologies has changed drastically over the past 20 years. The value of complex products and processes now overwhelms that of simple products and processes.

Sectors composed of simple processes and simple products represented 58 percent of the value of the top 30 exports in 1970 but only 12 percent in 1990. The contribution of key sectors involving complex processes and simple products rose from 12 percent to 36 percent; the value contributed by sectors involving complex processes and complex products rose from 31 percent to 51 percent. A quiet revolution has occurred.

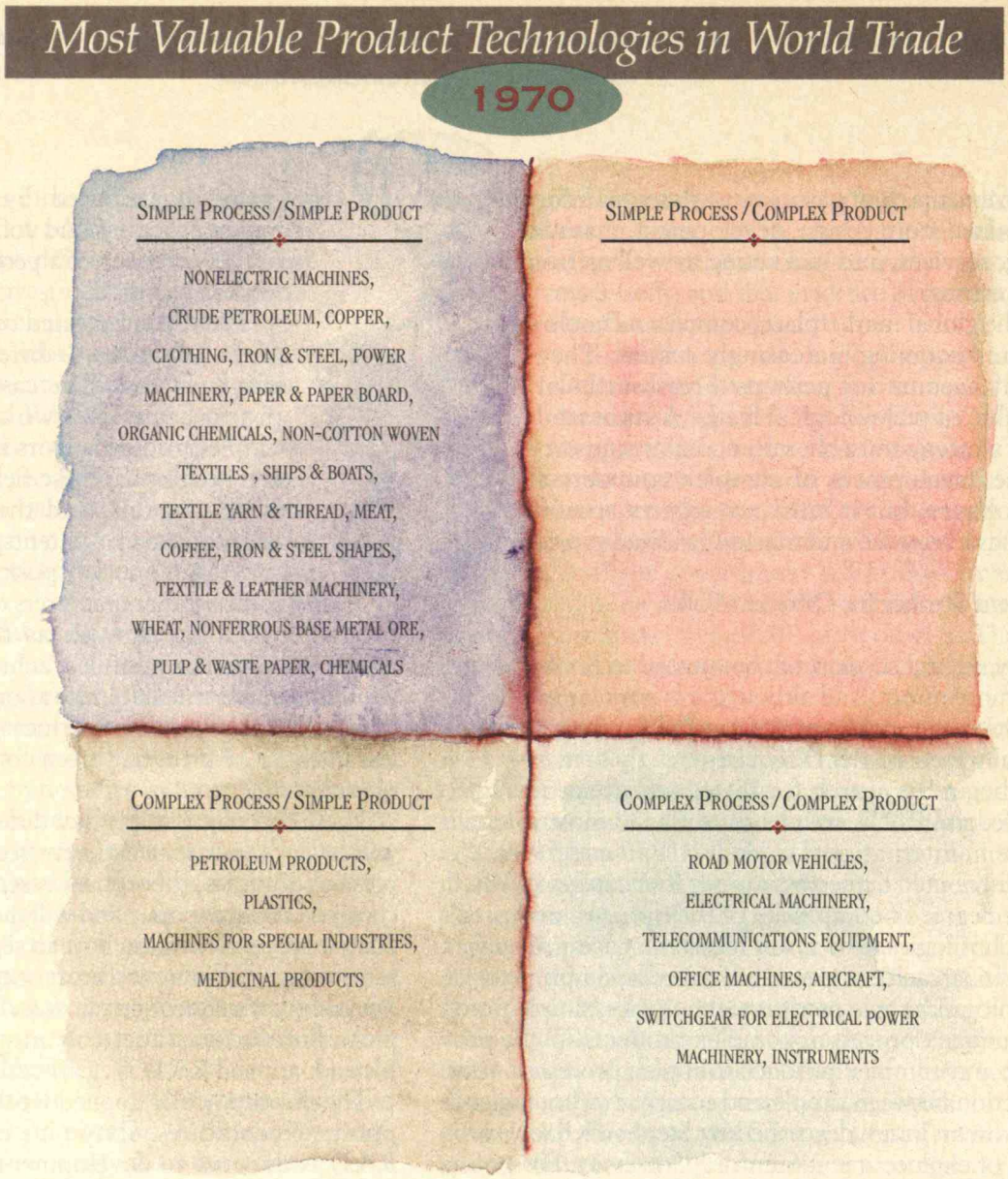
Valuable simple and complex technologies often follow quite different routes to economic success. The case of chemicals and pharmaceuticals—two of the most valuable simple-product sectors in 1990—is illustrative. Progress in these fields is based on radical innovations, and these innovations are often protected by patents, guaranteeing manufacturers a monopoly position in the market.

By contrast, manufacturers of valuable complex-product technologies, such as telecommunications equipment and automobiles, achieve success through continuous, incremental innovations. And for the most part, valuable complex-product technologies are far less likely to be protected from competition by secrecy or patents.

These differences imply that different R&D strategies will be appropriate in different sectors. For some simple technologies, theoretical research can be of great commercial importance and will most likely continue to contribute to innovation both in sectors that are important today and in new sectors such as biotechnology. For complex technologies, however, basic research often plays little or no direct role in commercial success. Instead, applied R&D is clearly crucial.

The importance of applied R&D is reflected in corporate expenditures. Sixty-nine percent of industrial R&D is devoted to development and 25 percent to applied research, with only 6 percent allocated to basic research. Complex sectors lead in self-financed R&D: office equipment manufacturers spent $16.1 billion for R&D in 1991 and the automobile industry $11.5 billion; the aerospace, telecommunications, and electrical and electronics industries each maintain R&D budgets of over $3 billion.

It is also important to note that advances in the processes by which products are made—as distinct from the development of new or refined products—have been critical to the success of both complex and simple products. For instance, the trade success of Japanese automakers rests largely on sophisticated process technologies, frequently described as "lean" and "agile." In the textile and clothing industries, which manufacture a simple product, the tight linking of retail and supply activities has created a complex rapid-response system that can adapt swiftly to changing market tastes. Chemical plants now use complex technologies to increase their efficiency, conserve energy, and cope with more stringent environmental constraints. And in other sec-



With regard to many of the products commonly traded in world markets, as well as the processes used to make them, complexity has grown over the last two decades. Basic research contributes little to the success of such products.

tors, as patents on simple products expire, competitive success depends on innovative processes that cut production costs. But despite the growing importance of process technologies, U.S. manufacturers have been more inclined to invest in product than process innovations, and more likely to search for new products or processes than to try to perfect existing technologies.

The size of the private-industry R&D budgets cited above might seem to confirm the conventional wisdom that federal R&D has no appropriate role in commercial applications. Yet signs of trouble abound. A 1992 report by the National Science Board, for instance, concludes that the growth in U.S. industrial R&D spending has slowed since the early 1980s, and that the allocation of these expenditures is less than optimal. The report cites an average annual real growth rate in R&D budgets of 1.3 percent between 1985 and 1991, compared with 7.3 percent between 1980 and 1985. This reduction in spending may be in companies' short-term interest, but it is not in the long-term interest of either industry or the nation. Many areas critical to maintaining the nation's industrial strength appear inadequately funded: according to the NSB report, the United States spends half as much as Japan on process-oriented R&D.

Other studies highlight the same defects and come to the same conclusions: the federal government must do more to fill the gaps that industry leaves. And an R&D policy that draws on our analysis of innovation in simple and complex sectors can more effectively target research funds to key commercially valuable industries.

Redirecting Research

To begin the process, the government should evaluate the commercial merit of its investments in R&D—basic and applied alike—much the way the National Science Foundation and National Institutes of Health evaluate potential projects for scientific merit.

Consider chemistry, a field that has obvious commercial value. University chemists have long prided them-

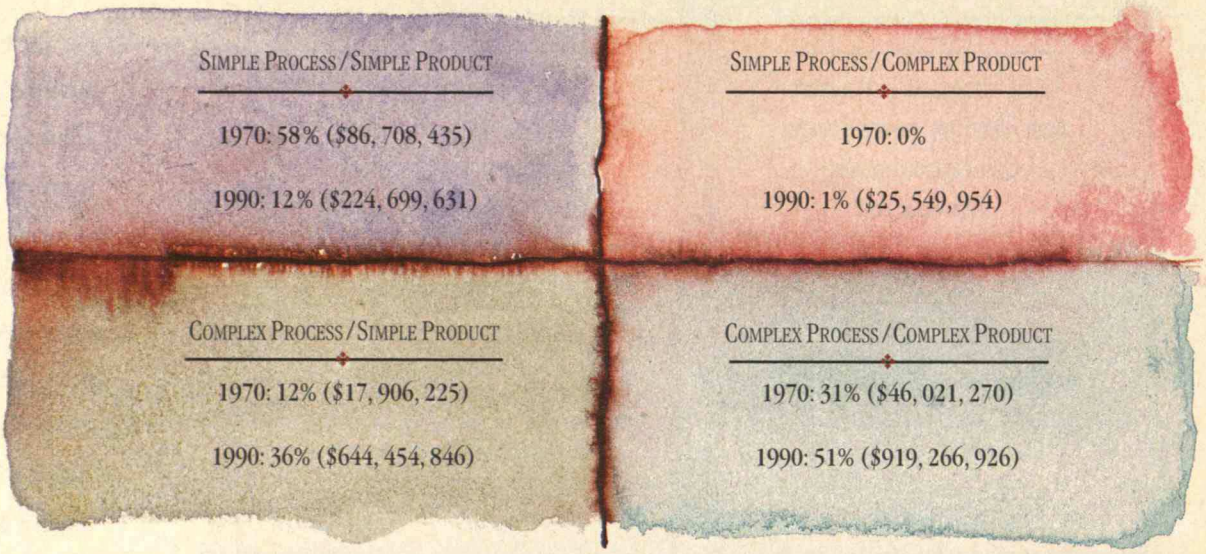
selves on contributing to "better living through chemistry," and they have been frustrated by the limited federal R&D funding chemistry receives relative to physics. Chemical research provides the same kinds of intellectual stimulus as physics, yet it also delivers continuous economic and social payoffs. By contrast, high-energy physics, the most costly fundamental science, has little apparent value to commercial technology. Much the same can be said for astronomy and space-based research. At a minimum, chemistry warrants a higher priority than it has received.

Redirecting federal R&D policy also entails changing the role of universities. In the first place, academic funding is spread across too many institutions. The overwhelming portion of high-quality research occurs at 50 or so colleges and universities. If only these top institutions carried out research on the current scale, federal investments in R&D would be more focused and productive. And to maximize the economic return from such research, the research universities must assign a much higher priority to assisting in its commercial use—perhaps emulating the model of land-grant colleges in agriculture. That task requires faculty to cross interdisciplinary lines, to link their work directly with industry, and to combine theoretical and experiential knowledge.

This implies that universities will also have to change the reward structure for their staffs. Instead of adhering to the "publish or perish" rule, promotion decisions should be made on the basis of evaluation by peers both within and outside the university, on the basis not only of an individual's research and teaching but also of his or her contributions to a given commercial field. Indeed, so much knowledge is held by groups rather than individuals that it may be inappropriate to evaluate the merit of individual achievements. Instead, granting across-the-board recognition to project teams might frequently be the best approach. Singling out individuals for recognition rewards competition, but in a commercial setting, cooperation is a far more successful route.

Simple vs. Complex in 1970 & 1990

A SUMMARY



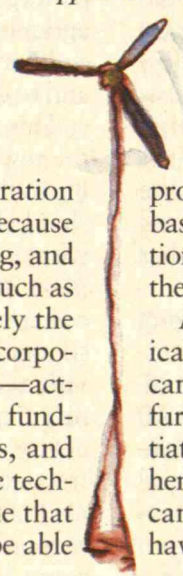
Investing in Process Technologies

As the National Science Board report and others have observed, government R&D expenditures are overwhelmingly (98 percent) focused on products, not processes, and most of the remainder is devoted to process technologies for defense applications. Investment in civilian process-focused R&D, then, must become a federal priority.

But innovation in process technology is far from straightforward; it draws on expertise that may be scattered across industry, government, and academia. Thus an important function of government support for process R&D is to create the networks needed to help spur innovation.

For example, the federal government should establish a well-funded but politically insulated corporation to respond to the changing needs of different sectors. This corporation would differ from, say, the Civilian Technology Corporation proposed by the National Academy of Sciences because it would have access to significantly more funding, and because it would target downstream innovation such as the fine-tuning of existing processes, not merely the upstream development of new techniques. This corporation must be prepared to play a variety of roles—acting as marriage broker in assembling a network, funding prototypes of both products and processes, and disseminating information, among others. Since technology evolves by trial and error, it is inevitable that many initiatives will fail; the corporation must be able to take the heat. At the same time, it must be free to cut its losses when an effort at innovation fails.

The expanding volume of trade in complex products, and in all products based on complex manufacturing processes, suggests that the U.S. government should shift funds toward applied R&D.



Meanwhile, Congress must embark on a dramatic reallocation of R&D funds. The goal of rationalizing U.S. R&D policy cannot be achieved incrementally. Given that overall federal funding is stable or declining, the only way to increase funding for commercial innovation is to divert needed resources away from commercial "losers" to "winners."

Of the roughly $67 billion federal expenditure on R&D in 1993, defense accounts for about 59 percent. Health, space, and energy absorb another 33 percent, with general science and other programs sharing the remainder. The largest chunks of money for funding commercially oriented R&D should come from the defense, space, and energy budgets, where vast sums are often justified as producing commercial benefits but rarely do. While we cannot propose specific cuts, a reasonable standard would be to base R&D funding for each agency on a careful evaluation of its contribution to the agency's mission—not on the faint promise of future spinoffs.

Achieving such goals is nearly always viewed as politically impossible, but the magnitude of the problem cannot be a barrier to action. Doing nothing will mean further deterioration in the U.S. position, while the initiatives we propose will set the stage for more comprehensive actions to follow. The federal R&D institutions can learn by doing, just as successful U.S. companies have done for quite some time.■

Mastering a New Role

In the 1960s, the U.S. government invested nearly $1 billion in supersonic air transport before abandoning the project as environmentally and economically unsound. In the 1970s, billions more were poured into an attempt to launch a synthetic fuels industry, a program that was abandoned when falling oil prices removed its economic rationale. Despite this unhappy history of federal government forays into civilian technology, many of the country's political and business leaders are advocating strong government action in support of industrially important technologies. Success of these efforts is possible, but it will require that some long-cherished organizational, conceptual, and philosophical china be broken.

First, we must recognize that government is seeking to master a new role. In the past, federal technology policy focused on the missions of particular agencies. NASA sponsored research on rocketry, for example, because NASA needed rockets to carry out its programs. Similarly, the Department of Defense funded the development of weapons and computer systems because these technologies served military ends. The commercial spinoffs were fringe benefits. The new thinking about technology policy, by contrast, explicitly targets industrial technologies that will serve the nation's economic development. Government agencies will no longer be the principal customers of many of these programs, but will instead serve as facilitators to the technology investment decisions of private companies.

Second, this new kind of technology policy calls for close working relationships between government and the private sector, as well as much heavier reliance on market forces to guide public investments and policies. In past federal attempts to steer technology, the government supplied virtually all the funding, or at least provided an incentive by guaranteeing a market for the products that would eventually come out of the R&D.

But since industry will now be the principal client, industry must be involved at all stages, helping to define, execute, evaluate—and fund—technology initiatives. Just involving industry in some advisory mode will not be sufficient. This approach opens up a danger of politically determined allocations, but that concern should not be overstated; both the National Science Foundation and the National Institute for Standards and Technology have successfully maneuvered the pork barrel course in the past.

Third, to ensure that resources are most effectively allocated, programs should be designed so that successes and failures can be readily identified and understood. Inattention to this element of a program can be costly; in the 1950s and 1960s, for example, the federal government continued to pursue weather modification technologies long after their ineffectiveness for most applications had been demonstrated. Methods

of judging success will need to be reconsidered, too. It is now common, for example, to assess a program's prospects by looking at the private sector's willingness to match public financing of precompetitive R&D. It may turn out, however, that a better gauge of success is the extent to which private investment is forthcoming at the next stage—commercializing the products and processes resulting from the subsidized R&D.

Fourth, a technology policy cannot succeed in a vacuum. Its success depends critically on economic policies that encourage investment in plant and equipment, on tax laws that favor investment over consumption, on trade policies that open markets to U.S. goods, and on an educational system that provides a workforce able to adopt and effectively use the new technologies. We must set up, in effect, a supportive ecology of policies to achieve the aim of a competitive, technologically advanced industrial base. While this idea is often given lip service, in practice it is often ignored.

Finally, we need some central means of orchestrating the activities of these myriad federal efforts. Without some mechanism to provide overall strategic guidance and to monitor progress, diverse efforts mounted by different agencies are likely to go off in different directions. Several organizations exist that could supply this coordination, such as the White House Office of Science and Technology Policy, the office of the vice-president, and the president's new Economic Council. The Office of Management and Budget will need to be involved as well.

Is this new experiment, in which government seeks to foster economic growth through changes in technology policy, worth pursuing? I believe so. Because the federal government lacks both practical experience in this endeavor as well as theoretical and historical signposts to guide it in this new role, we must invoke the spirit of "bold and persistent experimentation" with which President Franklin D. Roosevelt introduced the New Deal in an earlier age of economic uncertainty.■

ROBERT M. WHITE is president of the National Academy of Engineering.

PHOTO: CLAUDE VAZQUEZ

Losing the Cooperative Edge

CUTBACKS, layoffs, downsizing—American firms are getting leaner and meaner. These measures are often praised as signs of health, ways of restoring vim and vigor to American enterprise, making the nation fit for competition in a tough global marketplace. But is this really such a healthy process? Dramatic thinning can be a telltale symptom of anorexia, or worse.

Unsettling testimony on this score came in a conversation I had recently with a young mechanical engineer. He had just finished his first job out of college, working for two years in a consulting firm that advises dozens of small and mid-sized manufacturing firms on how to improve productivity. "What's the news from the front line?" I asked him.

A glum expression swept across his face. "The rule of thumb is: Get rid of people. People are expensive. So you automate where you can, keep a small permanent workforce, and fill in with temporary workers paid low wages and no benefits. That's where companies find their 'competitive edge' nowadays."

Ironically, the firms he'd seen—innovative and on technology's cutting edge—are the very ones the nation expects to create all those high-skilled, high-paying jobs that President Clinton likes to talk about. And the young engineer's observations ring true: although the economy is moving again, politicians and economists agonize over the disappointing quantity and quality of new jobs—a result in large part of workers' skills and large paychecks being targeted for elimination.

This jobless recovery illuminates a fundamental shift in social relations that bears watching. Economic and technical arrangements emerging in today's America are based on extremely weak human commitments. Innovations praised as "lean production" assume a high degree of fluidity in bonds that link persons and organizations. Companies do not hire for the long run. Workers do not enter jobs confident that they will be able to build meaningful lives around them. And because factories and offices can move almost overnight, relocating to satisfy market need, towns and cities can no longer rely upon strongly rooted companies to offer a stable economic base.

Such flexibility may make perfect sense from the standpoint of short-term efficiency and profit. But the long-term cultural costs could be enormous. Many of the social bonds and personal loyalties that traditionally sustained businesses, families, and local communities are being rapidly pared away. In Rust Belt towns of the Northeast, for example, this is reflected in gradual decay of once strong neighborhoods, rising crime rates, increasing drug use, and social services stretched to the breaking point. Communities depend on local businesses not just for paychecks and property taxes but for a whole array of support, ranging from sponsorship of Little League teams to equipment donations to schools. When central employers pull out or cut back, these social ligaments fall away. We need to ask: Even if the economy recovers, what will become of society?

One consequence of the rise of Lean America is a marked decline in our once-strong spirit of cooperation. The desire to do a good job is in large part a moral commitment to others, a motive that transcends economic necessity. But disillusioned workers who feel that the deck is stacked against them, that basic institutions of business and government no longer serve their interests, are less willing to invest extra energy. Innovation will also suffer. Workers who face the constant threat of layoffs, or who rent their labor on a daily basis through Manpower Inc. and other temporary contractors, are unlikely to wax creative. Why work for the good of the group when one's efforts are not reciprocated?

Not so long ago, the nation viewed its troubles as challenges to civic resolve. With enough will and cooperative effort, many people believed, we could eliminate poverty, rebuild the cities, achieve social equality, and eradicate crime. Today, the idea that Americans might pull together to solve common problems is greeted with hoots of scorn. Notice how quickly calls for "shared sacrifices" to reduce the deficit have degenerated into squabbles about "paying more taxes." Prodded by irate constituents, our leaders in Washington appear less interested in working together to fashion reasonable policies than in finding scapegoats when programs fail.

We now innovate in ways that weaken the institutions that formerly cushioned individuals and communities from the rough edges of technological change. Yet we seem unwilling to join hands to devise new social arrangements that are at once productive and humanly nurturing. That such a humane blend is possible is proven by the successes of other countries. Networks of companies in Italy, Germany, and Denmark, for instance, have shown that you don't have to be mean to be lean. But in the United States, the penchant for downsizing seems to have entered the nation's heart. ■

LANGDON WINNER teaches in the Department of Science and Technology Studies at Rensselaer Polytechnic Institute.

PHOTO: L. BARRY HETHERINGTON

Do You Know These Seven Ways to Increase Your Returns on Technology Transfer?

Technology Access will help you with six of them. You will have to supply the seventh.

Technology Access Report is the only concise, practical, independent newsletter devoted to helping you master the technology transfer process.

And since no publication can anticipate all your unique concerns, your subscription includes the toll-free ***Technology Access Hotline***. You'll enjoy prompt, confidential answers to your tech transfer questions.

Here's how ***Technology Access*** helps you master six critical success factors for technology transfer and commercialization:

1 Know the technology. *Technology Access* saves you hundreds of hours of research by reviewing a wide range of technology in non-technical, eminently readable English–ranging beyond your primary resources.

Genentech's Katie Cairati said, *"We review all of your technologies.* ***Technology Access*** *has become part of our program. And your information on what other companies are doing is extremely interesting. Nothing else is as specific."*

2 Know your own strategic goals and technical capabilities. Consultant Jeff Staley of **Generics Group USA** showed *Technology Access* readers how to perform technology audits and develop "technology asset plans," so you can decide what to develop internally or source from outside.

Key new trend: Universities are "packaging" related technologies from more than one institution. And **Sandia's** Dan Arvizu says the nation's 700 federal labs are assessing their own core capabilities, as they respond to industry's needs.

3 Know your potential partners–and competitors. *Technology Access* profiles the tech transfer operations of companies and not-for-profits in all sectors, so you can benchmark your performance against the world's best–and be prepared to deal when an opportunity arises.

Note: Every article ends with an easy-to-spot "Access Block" complete with name, address, phone and fax numbers. You save time by calling direct to the source.

4 Expand your network of technology suppliers, users and partners. *Technology Access* will expose you to the full spectrum of innovators: universities large and small, federal and independent labs, medical centers–and companies.

Said one scout for a major pharmaceutical firm: *"I didn't realize until I started reading* ***Technology Access Report*** *how much medical research goes on in the federal labs outside the National Institutes of Health. Thanks for opening my eyes!"*

Tip: Use our Calendar and conference recommendations to decide which to attend–and which meetings to read about in our Conference Reports. *Tech transfer is a contact sport.* We'll make sure you make the right ones.

5 Master the process. *Technology Access* shows you how to manage this powerful business strategy. Sure, too many bureaucracies, public and private, are consumed with process. But–as TQM, lean production and concurrent engineering have taught us, you ignore process at your peril. **Drexel** and **Oregon State**, and the **National Institute of Standards and Technology** as well as **GM**, are applying the precepts of TQM to their operations. So can you.

6 Scan the horizons. *Technology Access* will keep you from being blindsided–and alert you to unexpected opportunities. Information overload notwithstanding, it's critical to resist narrowing your focus. Biochemist Kathy Ku, **Stanford's** new licensing director, said, *"I depend on* ***Technology Access*** *for news and tactics I don't find in my usual sources."*

Only you can supply the seventh success factor.

7 Add *passion* to your tech transfer. John Preston's **MIT** licensing office has negotiated equity shares in startups with over $1 billion in combined market cap.

Here's John's formula: mix quality technology, management, inventors and investors. Then structure the deal with balanced incentives, so all will strive passionately for your venture's success.

Our passion is your success.
You benefit from our beliefs on every page: your business of technology transfer is *challenging*, but *manageable. It is important, stimulating* and *fun.* And ***Technology Access Report and Hotline*** will help you make it *very profitable.*

Order now to receive:
FREE *Technology Transfer Key Resource List*–durable, concise, annotated reference you'll rely on every day...
FREE heavy-duty padded binder to keep your issues and ***Resource List*** handy...
FREE use of the ***Technology Access Hotline***–quick answers to all your tech transfer questions, *and...*
PASSION–ENHANCING DISCOUNT
Save **$50** when you call today.

OUR GUARANTEE: ***You will get your money's worth from Technology Access Report and Hotline–or your money back.***

☐ ***Yes!*** Start my 12 monthly issues of ***Technology Access Report*** right away. I will receive the binder, ***Resource List*** and ***Hotline*** upon payment. Fee: Only **$397–SAVE $50** from regular price. Outside North America, add $75.

☐ Please bill me. ☐ Payment enclosed. (Save another $25.) ☐ Charge my Amex/Visa/MC

Exp. Signature

Name Title

Organization

Address/Mailstop

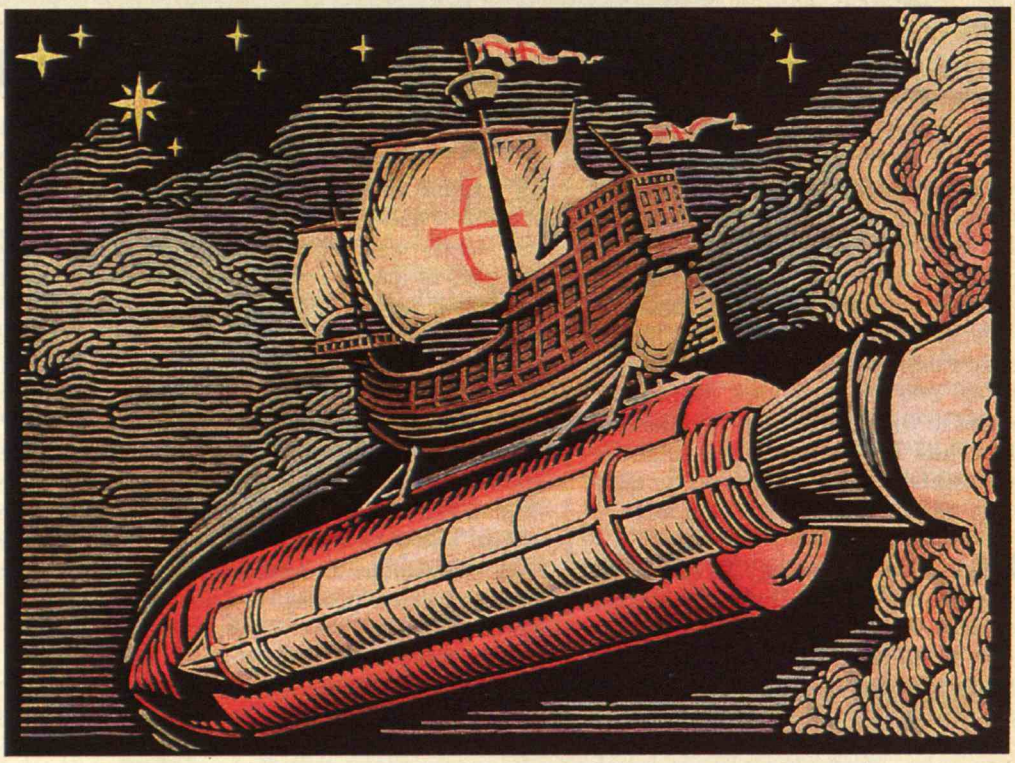
City State Zip

For fastest service, call toll-free **1-800/959-1059**, fax **510/549-4342**. Headquarters: 7 Mt. Lassen Dr., San Rafael, CA 94903. Bureaus: Washington, D.C., Paris, San Francisco

CODE: TR2

ALEX ROLAND

What Price, Columbus?



AT a White House meeting in October of 1960, aides raised with President Dwight D. Eisenhower the prospect of sending a human expedition to the moon. Ike replied that he was "not about to hock his jewels" to fund such an enterprise. The allusion, of course, was to Queen Isabella of Spain, who mortgaged some of her crown jewelry to finance Columbus's voyage to the New World. From the first flight of Sputnik in 1957 right up to the present, space enthusiasts have likened human spaceflight to the voyages of Columbus. Ike, for one, wasn't buying.

His successor, however, seized the analogy. John F. Kennedy called space "the new ocean," and he challenged the American people to race the Soviet Union to the next New World. To stimulate the economy he embraced deficit financing, a kind of mortgaging of the crown jewels. And with these funds he financed, among other things, an expedition to the moon, to be completed in the decade of the 1960s.

Now, more than 30 years later, advocates of the space station, missions to Mars, and colonies in space still invoke Christopher Columbus. Queen Isabella's investment, they argue, paled beside the returns that Columbus brought back from the New World. To hesitate in the face of risk is to atrophy and die as a civilization, to hand over to others the keys to our future. Daniel Goldin, administrator of the National Aeronautics and Space Administration, likens critics of human spaceflight to the Spanish courtiers who wrung their hands and warned Isabella not to risk her jewels.

But would the Spanish monarchs have backed the space station? The analogy begs the question. How do the costs—and financial benefits—of human spaceflight compare with those of the Columbus expedition of 1492?

In 1492, Ferdinand and Isabella received around 300 million maravedis in royal income from taxes and other sources. Columbus's expedition cost about 2 million maravedis, with 1.2 million of this coming from royal sources and the rest from private individuals; Columbus himself may have supplied about 225,000 maravedis, or 11 percent of the total. In other words, Ferdinand and Isabella contributed 0.4 percent of their annual income to support Columbus's first voyage.

How does the space program compare on that basis? Funding for the Apollo program peaked in 1965 at about $4 billion, out of a total federal budget of $118 billion. Thus, the United States spent in that year 3.4 percent of its national budget—more than eight times the proportion that Ferdinand and Isabella invested in Columbus's expedition.

But maybe it's not fair to make a comparison based on the peak year of space program funding. Still, from 1961 to 1972, the United States spent a total of $25 billion on Apollo and $1.8 trillion on the rest of the federal government. Thus, human spaceflight consumed about 1.4 percent of the federal budget during this period—three times the proportion that Ferdinand and Isabella put up for Columbus.

The United States has done more to underwrite human spaceflight than Ferdinand and Isabella ever dreamed of doing for Columbus, and has reaped nowhere near the financial reward.

Over the entire history of NASA,

ILLUSTRATION: BRUCE MADDOCKS

and Isabella put up for Columbus.

Over the entire history of NASA, from 1958 to 1993, the United States has spent $137 billion to put people into space. During this time, federal expenditures have totaled roughly $19 trillion, $4 trillion of which the country has borrowed, hocking not the crown jewels but our future. During this period, the U.S. government has invested, on average, 0.7 percent of its budget annually in human spaceflight—almost twice the percentage that Ferdinand and Isabella put up for Columbus.

Furthermore, private investment in human spaceflight has been negligible, and to the best of my knowledge no budding Columbus has put up 11 percent of the cost of his or her flight. John Denver reportedly offered the Soviet Union $7 million to ride as a passenger in space. But imagine an astronaut today putting up 11 percent of the $1 billion it costs to launch the space shuttle for the privilege of captaining a flight!

One might argue that it is more appropriate to compare exploration costs as a fraction not of government revenue but of the nation's annual production of wealth—what we now call gross domestic product. But because national budgets are a higher percentage of GDP now than they were in 1492, this analysis would reveal an even greater disparity in spending levels between Spain and the United States.

Gold vs. Moon Rocks

Any way it is measured, the United States has done more for human spaceflight than Ferdinand and Isabella ever dreamed of doing for Columbus. On average, for 36 years, we have given to this undertaking almost twice the percentage of national treasure that Ferdinand and Isabella gave to Columbus *just once*. After Columbus's first voyage, his royal patrons funded him and other explorers out of the profits of his expedition. Columbus brought back gold on the first shot. Astronauts brought back moon rocks.

It has been 32 years since Alan Shepard became the first American in space. By 1524, 32 years after Columbus's first voyage, he had made four round trips to the New World; the Spanish and Portuguese had established settlements in both North and South America, and on the Pacific and Atlantic oceans; Cortez was already in Tenochtitlán; and Spain was receiving 90 million maravedis a year from the New World. One-fifth of that, 18 million maravedis, went to the Spanish crown, yielding 1,500 percent annually on Ferdinand and Isabella's initial investment. By the end of the century, Spain was receiving 3.2 *billion* maravedis per year from the New World. The crown's share was 640 million, an annual return on investment of more than 50,000 percent.

It is a long way from Seville to Washington. In Columbus's day, the bureaucrats in the capital were naysayers and obstructionists, warning against a risky investment. They were wrong. The courtiers of the New World are starry-eyed enthusiasts, encouraging us to hock ever more of the crown jewels to support voyages that are still at sea after 36 years. The bureaucrats are wrong again. Ferdinand and Isabella would have drummed out of court anyone who proposed to fund Columbus for a third of a century with no financial return on the investment.

If the adventurers of the new ocean truly want us to emulate Ferdinand and Isabella, they might begin with this year's budget. Human spaceflight gets about $9.8 billion—approximately 0.6 percent of the federal budget. To reduce that to Ferdinand and Isabella's level, NASA would have to return to the Treasury something on the order of $3.2 billion and raise the balance from private sources—including about $1 billion from the captain of our human adventures. Then we might really find some new Columbus—or at least turn our attention to some more promising enterprise. ■

ALEX ROLAND is professor of history at Duke University and has served as a historian at the National Aeronautics and Space Administration.

Reviews

BOOKS

ELEMENT OF DANGER

Plutonium: Deadly Gold of the Nuclear Age
Howard Hu, Arjun Makhijani,
Katherine Yih et al.
International Physicians Press
(Cambridge, Mass.), $15

BY JONATHAN B. TUCKER

WHEN future historians review the follies of the twentieth century, they will give prominent place to the large-scale production of plutonium. Hundreds of tons of this radioactive element, which does not exist in nature, have been amassed since 1941, primarily for the manufacture of nuclear weapons but also as a nuclear fuel. Among the most toxic and long-lived substances ever deliberately produced, plutonium is one Cold War artifact that is still very much with us.

Although the United States stopped making plutonium in 1988, France, Britain, and Russia continue to produce, stockpile, and transport it in large quantities for ostensibly civilian purposes. (Plutonium can be used as fuel in specially designed "breeder" reactors, which produce more of the material than they burn, and in conventional light-water reactors in the form of mixed-oxide fuel.) Moscow plans to sell plutonium reprocessing services—the means by which the material is chemically extracted from irradiated nuclear fuel—for hard currency. Meanwhile Japan, which lacks domestic energy resources, intends to build a large reprocessing plant as the centerpiece of its long-range plan to achieve energy independence.

Ironically, the partial dismantling of superpower nuclear arsenals in the aftermath of the Cold War has exacerbated the dilemma of what to do with the military stockpile of plutonium. The United States is disassembling about 2,000 nuclear warheads each year and storing the plutonium in large vaults. Although the dismantling of U.S. weapons is eventually expected to release some 50 tons of plutonium, there are as yet no plans to destroy the stockpile or render it fully inaccessible. Russia has also begun dismantling its nuclear weapons and stockpiling military-grade plutonium, which it considers a resource of potential economic value.

The team of public-health and environmental scientists who wrote *Plutonium: Deadly Gold of the Nuclear Age* argues that the element should be treated not as a valuable resource but as a hazardous waste material. Given the "unacceptable security and environmental risks" associated with plutonium, they write, all countries should halt its production for both military and civilian purposes. The material would never be used again, and countries would work to develop effective disposal techniques.

Although the authors take a strong position against plutonium production, they buttress their arguments with scientific data rather than empty polemics. The picture that emerges is one of a technology out of control. Perhaps of greatest concern is the risk that plutonium could fall into the hands of irresponsible states or terrorist groups. The authors point out that even the impure plutonium made in civilian reactors—which consists of a mixture of isotopes—can be used to make a crude atomic bomb. Such a weapon would have a low and unpredictable explosive yield but could still destroy much of a city. The authors also suggest that states or terrorist groups that lack the technology to produce nuclear weapons might use plutonium in "radiological weapons," which would cause casualties through the toxic effects of radioactive fallout rather than through a nuclear blast.

The risk that plutonium produced in the former Soviet Union might be diverted for such nefarious purposes is of grave concern to nonproliferation experts. Indeed, the nightmare scenario of a black market in plutonium seems increasingly plausible in view of the deepening economic crisis, urgent need for hard currency, and weak government controls in the four former Soviet republics that possess nuclear weapons. The book touches only briefly on such security issues, however.

Too Hot to Handle

What most concerns the authors is plutonium's environmental and public-health effects. The postwar "nuclear priesthood" of scientists and policymakers who promoted the material as the ultimate military deterrent and an inexhaustible source of energy considered neither the health risks of manufacturing plutonium nor the environmental consequences of generating millions of gallons of extremely hazardous liquid wastes in the process. Though the authors of *Plutonium* paint a bleak picture, they argue that it is not too late to find a way out of this technological morass.

Plutonium is a far more potent carcinogen than any other human-made environmental poison. It emits alpha particles, a high-energy form of ionizing radiation that is particularly damaging to the DNA of living cells. In its metal form, the element is also chemically reactive and can ignite spontaneously when exposed to air. Once inhaled, microscopic specks of plutonium can

ILLUSTRATIONS: BRUCE MADDOCKS

linger in the human body for decades, irradiating lung tissue and eventually migrating to other organs such as the liver and bone, where they may produce other cancers.

The authors of *Plutonium* summarize recent experiments in dogs suggesting that alpha radiation may be even more dangerous than previously believed. Extrapolation from the animal data to adult human beings suggests that about a millionth of an ounce of inhaled plutonium will cause lung cancer with virtual certainty. Lower doses of alpha radiation induce chromosomal damage that can be passed on to future generations.

Besides the health hazards posed by plutonium itself, the standard method for chemically extracting the element from irradiated nuclear fuel—known as the Purex process—results in a witch's brew of toxic chemicals and long-lived radioactive isotopes. These extremely dangerous, hard-to-handle wastes are typically stored in large steel tanks, such as those at the Hanford Reservation in Washington state. Over the years, some of the tanks have corroded and leaked highly radioactive materials into the surrounding soil, while others regularly generate large bubbles of combustible hydrogen gas, raising the specter of a potentially disastrous explosion.

Russia's contamination problem is even worse. Plutonium production facilities such as Chelyabinsk-65 in the Ural Mountains and Tomsk-7 in Siberia (where a nuclear accident occurred in April) routinely dumped high-level radioactive wastes directly into the air or water or injected them underground. According to the authors, one area on the shore of Lake Karachay, near the Chelyabinsk facility, is so polluted with plutonium wastes that one can receive a fatal dose of radiation simply by standing there for an hour.

Flawed Proposals

By recounting such devastation, the book makes a compelling case for halting plutonium production. The authors' appeals for official candor are also

sound. For example, they urge the United States and other governments to lift the veil of secrecy that still surrounds the environmental consequences of plutonium production, including the precise composition of liquid wastes in storage tanks. To help assess the public-health effects of plutonium exposure, they call for an independent, nongovernmental study of the 1957 explosion of a high-level waste tank at Chelyabinsk, a disaster that was concealed for more than 30 years by both the U.S. and Soviet governments.

It is in prescribing actual remedies that the book is less persuasive, since the authors—all medical and environmental scientists—often fail to consider broader political issues. The method they favor for disposing of plutonium is to adulterate it with other highly radioactive wastes, mix the material with molten glass, and permanently store the glassified mixture in deep underground repositories. The problem is that both the United States and Russia have so far been loath to treat their hard-won plutonium as a waste material rather than as a valuable fuel.

An alternative approach being considered in both countries would be to "burn" plutonium in a special fast-neutron reactor that fissions it into shorter-lived elements while generating electricity but without breeding more plutonium-239. This option is flawed as well, however, since it would require the costly step of converting plutonium metal into oxide fuel; given the current low price of uranium, using plutonium to generate power does not make economic sense.

Pending resolution of the disposal problem, the authors argue for placing all military and civilian plutonium under "secure international control" to prevent it from being used for military purposes, but they do not address the political obstacles. As long as Russia retains large plutonium stockpiles, the United States will want to preserve the option of reusing plutonium from dismantled nuclear warheads in future weapons, should the need arise. The U.S. government has also refused to allow foreign inspectors into its plutonium storage facilities, for fear that they might acquire highly classified information—such as the precise size and shape of the plutonium "pits" in warheads—that could help an aspiring nuclear state develop its own weapons. Yet reciprocity in inspections of plutonium storage sites would be essential for verification.

One possible solution to the monitoring problem, proposed by a working group of U.S. and Russian physicists meeting under the auspices of the Federation of American Scientists, would be to place the plutonium pits in secure containers with tamper-proof seals. By measuring the type and intensity of emitted radiation from outside the container with a gamma-ray spectrometer, it would be possible to verify the presence of plutonium pits without disclosing sensitive information on weapon design. Thereafter, inspectors would simply check the seals periodically to make sure they remained intact.

The unspoken theme of *Plutonium* is that for humankind to survive, it must abandon its Faustian quest for godlike power and learn to live within its means and in greater harmony with nature. To this end, the authors call implicitly for a new paradigm of military and economic security that gives rise to less "toxic" material byproducts and geopolitical structures. Yet the book fails to offer a practical roadmap for getting to this desirable destination.

Despite the utopian quality of some of its recommendations, *Plutonium* is a commendable effort to clear away the jumble of misinformation and hyperbole that surrounds this complex and contentious issue. Refreshingly, it neither overstates the dangers of plutonium, as environmentalists often do, nor understates them, as the nuclear industry often does. The result is an enlightening and disturbing portrait of a problem that not only we but our distant descendants will have to contend with.■

JONATHAN B. TUCKER is a former analyst in the international-security program at the congressional Office of Technology Assessment.

SOFTWARE

SCIENCE CLASS WAS NEVER LIKE THIS

"Quarky & Quaysoo's Turbo Science"
Sierra Discovery Series
Jeff Tunnell Productions (Eugene, Ore.), $49.95

BY RONALD SOKOL-MARGOLIS

MY three kids have played a lot of computer games. Their favorites tend to be those intense white-knucklers with names like "Maelstrom," "Beyond Dark Castle," "RoboSport," and (ouch!) "HemiRoids." Such thrillers certainly advance young children's fine-motor skills and ability to strategize, but like television they are far more entertaining than educational. I am somewhat relieved when the kids load up "Tetris" or "Weltris," which build hand-eye coordination without the accompanying explosions and body counts. These games are only slightly less exciting than the war games, since the player is still racing against the clock—and at least the child can sit back in the chair and maintain good posture.

Quiz games like "Jeopardy" have a stronger educational component, but they teach only facts, paying little attention to the process of learning.

As an education-conscious parent, I have often wished for games that not only are fun but actually deposit some residual knowledge in the child. By "knowledge" I mean *true* knowledge: information gained from experience.

Happily, innovative developers of educational software have begun to oblige *(see "Video Games That Teach?" on page 50)*. A wealth of interactive games now provide excitement while encouraging intellectual choices. The "Sim" series, for example—"SimCity," "SimLife," "SimAnt," and "SimEarth" (published by Maxis)—allows the player to explore design options for cities, environments, and even planets, then see the results of these godlike decisions. The "Math Blaster" series (Davidson) is an engaging primer on decimals, fractions, and pre-algebra concepts. And the always fascinating "Carmen Sandiego" series (Brøderbund) is full of alternative pathways on the road to learning about history and geography.

One of the more imaginative and effective educational software packages to emerge recently is "Quarky & Quaysoo's Turbo Science." (The current version is for MS-DOS, and requires VGA graphics and at least a 386SX processor and 640K memory; a Macintosh version is due out soon.) Designed for ages 9 to 14, "Turbo Science" presents science problems in the setting of a race in which the player joins up with either Quarky or Quaysoo, who, by the way, are brother and sister aliens. The two aliens both goad and encourage the child to compete against a set of shady computer characters that rush from checkpoint to checkpoint through a series of geographical obstacles, such as oceans, rivers, or deserts, to get to the finish line.

The strategic challenge is to minimize the time spent traversing the obstacles. Players choose from five modes of transport, ranging from walking (the slowest) to ultralight aircraft. The faster you travel, however, the faster your com-

puter "bank account" shrinks. Thus, youngsters learn not only about alternative speeds of travel but also about the relative costs of these choices.

You can earn more money by visiting various cartoon "landscapes" and answering questions about them. This, presumably, is how most of the learning takes place. At the Big Wave Beach, for example, the questions concern energy, matter, and physical forces. The first question here is where the highest water pressure can be found—at the bottom of a wave on which Quarky is surfing, inside a camper's pressure cooker that is steaming on a fire, or in a trench of water at the beachside. While some questions can be answered intuitively, most, like this one, require some research.

Aiding the young scientists is an electronic "toolbox" containing a scale, a thermometer, a tape measure, a volume beaker, a voltmeter, light and sound meters, and other instruments, most of which can switch between English and metric. Presented with the question about water pressure, a player might rummage about in the toolbox, pull out a water-pressure meter, and, using the computer mouse, drag the meter around the screen to measure the forces in each setting before venturing an answer.

One particularly fascinating landscape is a set of electrical generating stations powered by hydro, wind, and steam. To answer the questions, players must compare the water pressure at the top and bottom of the hydropower waterfall, determine wind direction at the wind turbines, and measure the temperature of the fire (or nuclear reaction chamber), water, and steam that drive the steam turbines. Other landscapes cover such topics as changes in states of matter; electricity and magnetism; gravity, mass, and momentum; and atomic structure.

My oldest, at 15, found most of the questions too easy. But my youngest kids (10 and 12) were excited by all of these landscapes. I'm with them. While few players would have trouble deciding which is hottest—boiling water, a bonfire, or the sun—even an adult might be challenged by a question like "How do molecules account for the transfer of thermal energy from a 'small hot thing' to a 'large cold thing'?"

For anyone who doesn't understand a concept, "Turbo Science" offers a more traditional tool: a 150-page research guide. Just click on the book icon and you will be referred to the proper page number in the guide. The younger kids were enthusiastic about resorting to the book—it is highly entertaining, with cartoon characters and silly stories intertwined with scientific facts. And I like the way such off-screen research reinforces the need to spend time gathering the facts required for solving a problem.

About the only thing "Turbo Science" doesn't do is teach teamwork. It is a one-player game—the youngster versus the computer. The absence of a second player underscores the lack of socializing experiences in computer training (and TV, for that matter). Real scientific investigation, after all, requires collaboration, a point that the developers ought to consider in designing the next generation of the game.

But "Turbo Science" is still a big advance over my own junior-high-school science days, where "memorization of a body of facts" was the modus operandi. The product skillfully integrates visual perception, reading, and testing to help kids understand by doing. And to my delight as a parent, it achieves this aim without the lure of combat aggression or the instant gratification of winning points.

The game's developers foresee the future of science education as computer-based, interactive, and individualized. Seymour Papert, a professor of learning research at MIT, agrees. In his recent book, *The Children's Machine: Rethinking School in the Age of the Computer*, Papert complains that today's electronic teaching methods have "tragically squandered the computer's potential to enhance education." Software developers, he argues, should respect the child's right to intellectual self-determination and dump the idea of a "single, uniform way of learning." With its mix of on-screen visuals and tools and off-screen resources, "Turbo Science" is a well-designed model for this future.■

RONALD SOKOL-MARGOLIS, chief information officer at Harvard Medical School's Joint Center for Radiation Therapy, has learned everything he knows about computer games from his three sons, Nathan, Samuel, and Joseph.

CONTINUED FROM PAGE 8

A third factor that will support regular and continuous student use of computers and other technologies is improved software. In the first wave of classroom computers, programs emphasized instructional practices such as meaningless drill that stifle interest and creativity. But new software takes advantage of emerging technologies. While in the California Department of Education, I was part of an effort to support the production of GTV, a multimedia project developed by National Geographic, Lucasfilm, and Apple Computer that provides over 40,000 images to engage students in the study of history. By contrast, when I started teaching I created a picture file for history instruction and was pleased to pull together 2,000 images.

We do seem to be learning from our mistakes, and some of the most productive and creative work in education is occurring now as part of an effort to reinvent schools. I share Papert's optimism about new approaches to teaching and learning—so much so that I recently joined the Edison Project, which aims to design schools that meet the needs of today's children and their families. It is my hope that this project and others like it will transform education, not only engaging the hearts and minds of students but also amazing the time travelers Papert imagines.

FRANCIE ALEXANDER
Deputy Director of Curriculum
The Edison Project
Washington, D.C.

I am not against computers—I am writing this letter on my MAC LC II—but I find it difficult to understand why so many educators and would-be educators consider the computer the be-all and end-all of education, problem solving, communication, and God knows what else. I have discovered, from experience, that when students don't know how to plot a graph, giving them a program that plots it for them is a mistake. And when they don't understand algebra, giving them a program that solves algebra problems for them is also a mistake. I've never met a computer that could scold an unruly child, answer a question with a question, evaluate a student's potential, spot dyslexia, crack a

timely joke, or commiserate with someone who has a headache or a personal problem. The computer doesn't seem to be the answer any way I look at it. It's just another tool.

JOHN ROSS
Morrisville, Pa.

VERNE'S VISIONS

In his letter on futurism (*"The Shape of Things to Come," TR Letters August/September 1993*), Arthur C. Clarke blames H.G. Wells for suggesting that a gun rather than a rocket would send the first space travelers to the moon. But if my memory serves me adequately, Clarke can excuse Wells and place his displeasure on Jules Verne, whose novel *From the Earth to the Moon* excited me in my younger years with its description of cannon-launched space adventurers who view the far side of the moon.

Verne also introduced what must have been a nuclear-powered submarine in *Twenty Thousand Leagues under the Sea*. Though perhaps he was not the equal of Wells, he was a teller of fascinating and imaginative tales and should be forgiven for using gunpowder rather than rocket fuel to propel his space vehicle. He also deserves mention as a futurist of his day.

On to 2001!

C. MALLORY GRAVES
Lynchburg, Va.

SPEEDY SOUND

In "Ocean Soundings" (*MIT Reporter, TR May/June 1993*), Robert Cooke states that for each 1° Celsius increase in temperature, "the velocity of sound in seawater rises 4.6 miles per second." I believe it should be 4.6 meters per second instead.

WARREN HIMMELBERGER
Wellesley Hills, Mass.

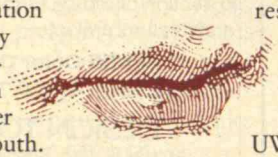
Classifieds

PERSONALS

Phenomena

By David Brittan

ROVING GLANDS ❧ People undergoing treatment for head or neck cancer might benefit from a slight rearrangement of body parts, according to a dental researcher at Tufts University. The salivary glands, crucial for chewing and swallowing and for keeping teeth healthy, are often destroyed along with cancerous tissue during radiation therapy. But they could find a temporary haven somewhere other than in the mouth.



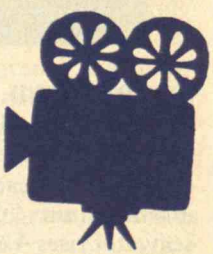
"Because most head and neck cancer patients have to go through some surgery prior to radiation," says Maria Papageorge, an assistant professor at the university's School of Dental Medicine, "why not try removing a salivary gland while the patient is undergoing surgery and replanting it in a radiation-free part of the body?" The abdomen, for example. When Papageorge performed such surgery on laboratory animals, the displaced gland survived for 10 days. If connected to blood vessels at its new location, she says, a salivary gland might last the 30 days that radiation therapy normally takes. The gland would then be returned to its customary site.

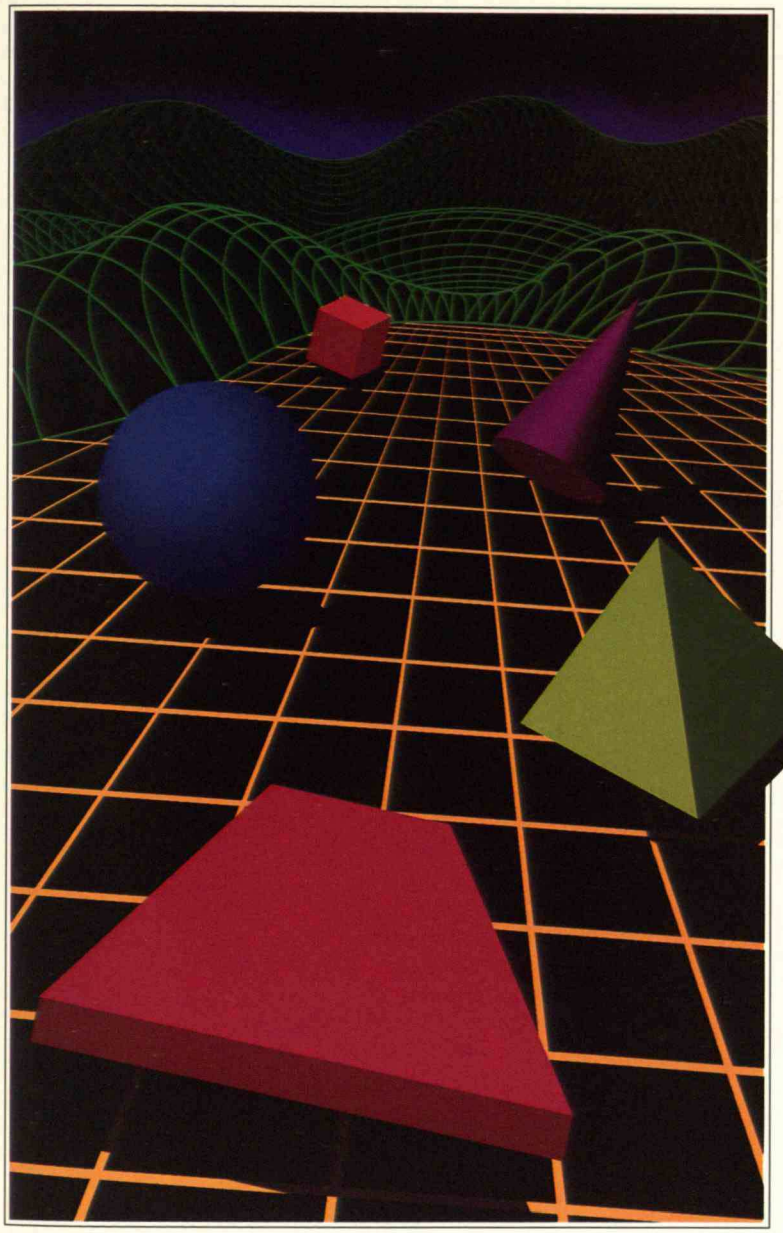
MMM IS FOR MAPLE ❧ And what could stimulate the salivary glands more than a stack of pancakes smothered in maple syrup—except maybe a stack of pancakes smothered in maple syrup with enhanced vanillin content? Three food scientists at the University of Wisconsin have studied consumers' reactions to different flavor components of America's favorite breakfast syrup and believe they have found a way to make a good thing even better. Like fine wine, maple syrup gets its complex flavor and aroma from a variety of chemical ingredients. A compound called guaiacol imparts a smoky taste. Furaneol adds a hint of caramel and cotton candy. Two other compounds, maple lactone and sugar furanone, provide that "mapley" flavor. To learn which blends of flavors people like best, the researchers—Robert Lindsay and Andrea Belford of UW-Madison and Stephen Ridley of UW-River Falls—concocted several synthetic brews that simulated different grades of maple syrup. The syrups were administered to test subjects on a substrate of Aunt Jemima Toaster Waffles. The subjects showed a marked preference for darker, more robust syrups, which, among other things, are richer in the flavor component vanillin than the light, delicate syrups that are traditionally priced the highest. Besides lending maple syrup a subtle note of vanilla, vanillin is thought to have a "smoothing" or "flavor-blending" effect. Unfortunately for syrup producers, the vanillin content of maple sap is not easily controlled: it depends on variables such as tree height, soil composition, and climate. The food scientists have sidestepped these natural obstacles by developing a technique for artificially boosting levels of the crowd-pleasing compound. In raw maple sap, vanillin is chemically bound to sugar molecules in the form of vanillin glycoside. As syrup producers boil down the sap, some of the vanillin—about 30 percent—breaks away from the glycoside, adding its flavor to the finished product. But in a process that has yet to be tried outside the lab, the Wisconsin researchers treat the syrup stock with enzymes that release even more of the vanillin from its bound form. This way, even a vanillin-poor sap can be turned into a syrup with the taste that consumers are stuck on.

LICE OF WRATH ❧ The favorite breakfast syrup of the phylloxera louse is the rich juice found inside the roots of California grapevines. Some two-thirds of the vineyards in Napa and Sonoma counties are susceptible to the louse, which kills the grape plants it infests. Worried winegrowers have turned to NASA for help. Over the next three years, a project called Grapevine Remote sensing Analysis of Phylloxera Early Stress (GRAPES) will measure the bug's progress by detecting plant damage even before it becomes visible to the naked eye. In a classic instance of new wine in an old bottle, the U-2 spy plane of the Cold War, adapted for civilian use and renamed the ER-2, has begun collecting data on the region. Earth-imaging satellites, meanwhile, are providing a big-picture view. By analyzing infrared emissions from grapevines, spectrometers aboard these craft can spot changes in chlorophyll and potassium levels caused by underground mischief. Once the data are in, wineries will know how quickly they need to replant their vineyards. Because the louse lives four to six feet underground, pesticides can't touch it, according to Joan Salute, who manages the GRAPES project at NASA Ames Research Center. But after vineyard owners have grafted their plants onto rootstocks other than the European-derived strains that phylloxera favors, its days of wining and dining will be over.

CHASING CARS ❧ On the highways, infrared spectrometers can monitor pests of the human variety: drivers who violate air-quality laws. Smog Dog, a roadside pollution detector developed by Hughes Aircraft's Santa Barbara Research Center, measures carbon monoxide, carbon dioxide, and hydrocarbons in the exhaust of up to 2,000 vehicles per hour. An on-site camera records the license plate numbers of offending vehicles to allow state or local enforcement agencies—which Hughes sees as its potential customers—to track down the culprits.

HOLLY ❧ That's "Hollywood" without the "wood," yet another green idea to emerge from the Coast. Under pressure from environmental groups, Los Angeles film studios are weaning themselves from the 250,000 sheets of tropical timber–based plywood they have been using each year to build movie sets. Hollywood Center Studios was the first to swear off wood from endangered rainforests, in 1990, reports environmental consultant David Kupfer in the summer 1993 *Earth Island Journal*. Now several other studios, including Walt Disney, MCA/Universal, and Paramount, have started using substitutes made from wood scraps or recycled paper. Still, Kupfer laments, "Hollywood is nowhere near being a sustainable industry." Funny, they've been recycling scripts for years.



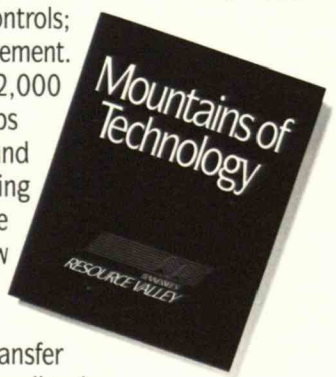


Proving Ground For Technology Of The Future.

In the heart of the Great Smoky Mountains is a valley of innovation, where companies of all sizes are accessing an astounding concentration of applied research and technology for products and processes that are making them more competitive in the world marketplace.

They're accessing information through Martin Marietta Energy Systems, operator of the Oak Ridge National Laboratory and the Department of Energy's Defense Manufacturing facilities at Oak Ridge; the University of Tennessee; and the Tennessee Valley Authority.

Technologies available for transfer include all aspects of manufacturing technology; materials science, including metals and ceramics; instrumentation and controls; and waste management.



The result is 12,000 new high-tech jobs just since 1984, and 2,500 Ph.D.'s living and working in the sheltering shadow of the Smokies.

For a copy of our technology transfer brochure, write or call today.

4497 017

TENNESSEE'S
RESOURCE VALLEY™
A Community of 15 Counties in East Tennessee

Suite 101, 6016 Brookvale Lane
Knoxville, Tennessee 37919, (615)584-6445

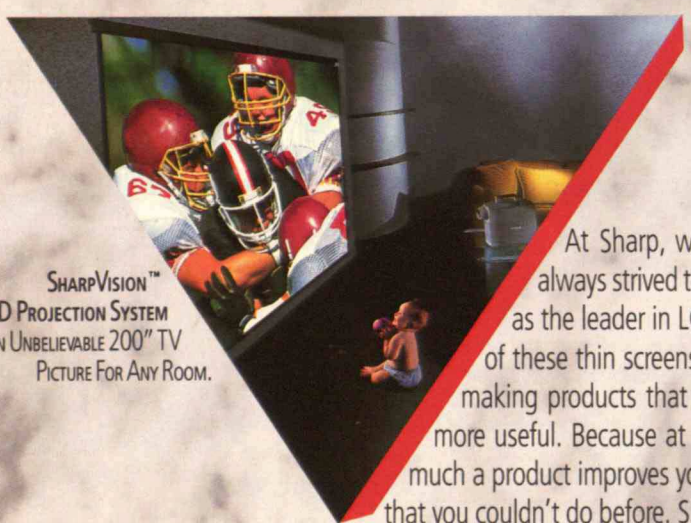
THE TECHNOLOGY IS LCD.

THE TECHNOLOGY LEADER IS SHARP.

SHARP VIEWCAM™
THE WORLD'S FIRST
CAMCORDER WITH THE
AMAZING 4" LCD VIEW SCREEN.

SHARPVISION 4" LCD TV
INCOMPARABLE PICTURE QUALITY
YOU CAN ENJOY ANYWHERE.

TOUCH SCREEN WIZARD®
THE INCREDIBLE LCD SCREEN
GIVES YOU A TOUCH OF GENIUS.



SHARPVISION™
LCD PROJECTION SYSTEM
AN UNBELIEVABLE 200" TV
PICTURE FOR ANY ROOM.

At Sharp, we don't look at things like other companies. We've always strived to create products that are both innovative and friendly. And as the leader in LCD (Liquid Crystal Display), the technology that's made all of these thin screens possible, we take that ideal to a new level. It's all about making products that are not only more colorful and exciting, but significantly more useful. Because at Sharp, we believe that true innovation is defined by how much a product improves your life. How enjoyable it is to use. And what it lets you do that you couldn't do before. Sharp LCD. Bringing you much more than you ever imagined.

SHARP LCD. YOU WON'T BE ABLE TO PICTURE LIFE WITHOUT IT.

LCD

1-800-BE SHARP

SHARP®
FROM SHARP MINDS
COME SHARP PRODUCTS™

APPLIANCES • AUDIO • CALCULATORS • CAMCORDERS • COMPUTERS • COPIERS • ELECTRONIC ORGANIZERS
FACSIMILE • LCD PROJECTION SYSTEMS • PRINTERS • TELEVISIONS • VCRs